A. M. A.
ARCHIVES OF
OTOLARYNGOLOGY

EDITORIAL BOARD

GEORGE M. COATES, Chief Editor
1721 Pine Street, Philadelphia 3

WESTLEY M. HUNT, New York
RALPH A. FENTON, Portland, Ore.
ERNEST M. SEYDELL, Wichita, Kan.
CHEVALIER JACKSON, Philadelphia
ROBERT L. GOODALE, Boston
J. MACKENZIE BROWN, Los Angeles
CARL H. McCASKEY, Indianapolis

RICHARD J. PLUNKETT, M.D., Chicago, Managing Editor

OCTOBER 1950
VOLUME 52 NUMBER 4

AMERICAN MEDICAL ASSOCIATION
535 NORTH DEARBORN STREET • CHICAGO 10, ILLINOIS

THE NAME TO DEPEND ON...

DeVILBISS

A comprehensive development and research program assures you of the most efficient in nebulizers and atomizers

The continuing DeVilbiss research program, now more comprehensive than ever before, is keeping pace with the latest findings in the field of aerosol therapy.

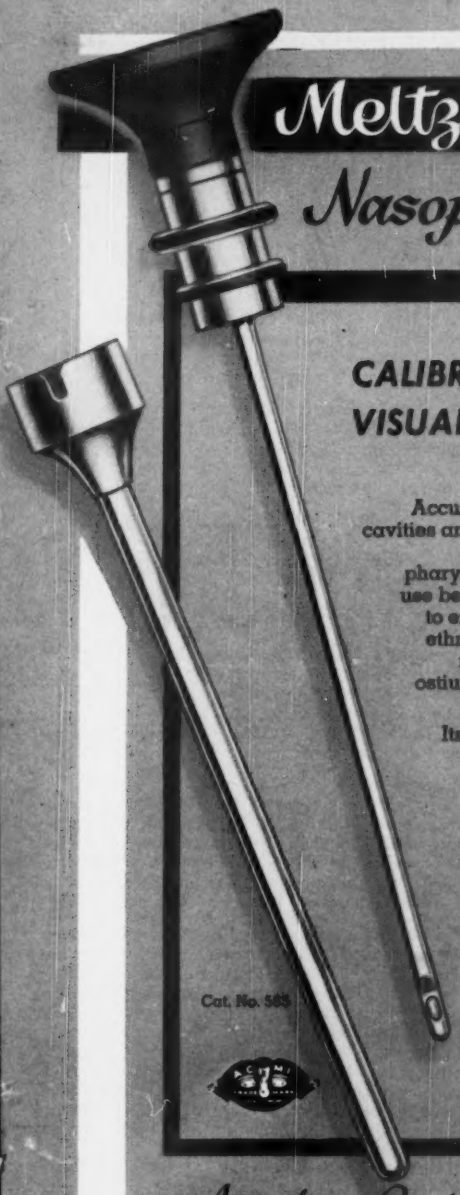
DeVilbiss' close cooperation, particularly with the pharmaceutical houses and research foundations, has resulted in the exactly *right* piece of equipment being always available for new techniques. There is an atomizer available for any new combination of pH, viscosity, or surface tension likely to be encountered.

DeVilbiss deserves your confidence. Over the years, no other manufacturer of similar equipment has worked so closely with research development to the end that the physician would have exactly the *right* type of equipment for the job at hand.

De Vilbiss...

ATOMIZERS
NEBULIZERS
VAPORIZERS

Meltzer
Nasopharyngoscope



CALIBRE—7 Fr.

VISUAL FIELD—large, sharply defined, high contrast

Accurate, detailed inspection of the smallest cavities and canals of the nasopharyngeal region is now possible with the Meltzer Nasopharyngoscope. Its minute calibre permits its use between the middle turbinate and septum to explore the superior meatus and sphenoethmoidal regions. It can be used under the middle turbinate to study the accessory ostium and the bulla ethmoidalis and openings of the ethmoidal cells can be seen.

Its coated lens system and cartridge type lamp produce a brilliantly illuminated, sharply defined image. The superior optical properties characteristic of A.C.M.I. telescopes are retained in the Meltzer Nasopharyngoscope. The cartridge type lamp located adjacent to the objective lens assures maximum illumination. Coated lens system provides a large visual field, sharply defined and free from internal reflections. A protective sheath that may be used as a sterilizing chamber is supplied with the instrument.

Cat. No. 565

American Cystoscope Makers, Inc.

1241 LAFAYETTE AVE. FREDERICK J. WALLACE, President NEW YORK 59, N. Y.

(Advertisement)

PSYCHOSOMATIC ASPECTS OF HEARING DEFECTS

The Effect of Noise on Hearing

Number 10 of a Series

A defect in hearing initiates emotional and practical problems which profoundly affect the individual's attitude toward himself and society. In turn his handicap influences the way people act toward him. Some aspects of this complex problem are briefly discussed in this time-saving refresher for the busy practitioner.

HEARING DEFECTS—AN OCCUPATIONAL DISEASE

The list of occupations where loss of hearing is common is a long one: artillerists, caisson workers, boilermakers, machine-shop workers, railroad employees, aviators,[1] miners, riveters, radio operators.[2] Indeed, any occupation with exposure to noise of over 90 decibels may cause injury to the ear.[3] The highest prevalence is among skilled and semi-skilled industrial employees, the lowest among professional, business and clerical workers.[4]

There is no doubt that noise causes actual damage to the organ of Corti;[1] "the pathology consists of a degeneration in the cells of the spiral ganglion following changes in the hair cells of Corti's organ, and is most marked in the basal turn of the cochlea."[2]

Some ears are more susceptible to damage than others;[2] those of the young are probably more easily harmed than those of the middle-age or older.[3] An ear with a pre-existing conduction lesion is probably less susceptible than one with normal hearing.[3]

But though noise damages hearing, it is necessary to the understanding of the problem to determine the type of noise which causes the damage. Continuous noise is less injurious than repeated loud sounds, for the brief compression impulse may be of great magnitude.[2] High-pitched sounds cause more damage than low.[2] The length of exposure to the noise, the length of the periods during which the noise is interrupted, the presence or absence of reverberations to the noise—all these are important factors in determining the extent of the damage that noise may do to the hearing of workers.[2]

EMPLOYERS SHOULD MAKE PRE-EMPLOYMENT HEARING TESTS

Formerly only traumatic deafness was recognized as an occupational disease. Today, courts, insurance companies and industrial commissions have recognized that hearing loss due to noise may be considered an occupational disease.

The implications of such decisions are tremendous. Companies where noise is a problem may find themselves faced with compensation claims which are financially burdensome, if not ruinous.

As few firms have pre-employment records of the hearing status of their employees they have no way of knowing whether or not hearing defects which are discovered during employment are due to occupational causes. Indeed, it is by no means impossible for a hard-of-hearing worker, if unscrupulous, to claim compensation for a defect which was present before his employment began.

This situation is one of importance to every physician who does any industrial work at all. It is his responsibility to apprise his employers that they are open to damage suits which, though often justifiable, *may* be entirely unjustified. Nor need the industry involved be one in which noise is obviously present, such as an airplane factory, or a machine shop. Even a telephone operator or a radio operator may suffer acoustic trauma.[7]

To protect the employer against unjustified claims, records should be made of the hearing of all employees, certainly of all those working in parts of a plant where noise is a problem. A change of occupation of those found susceptible to noise may also be recommended.

Nor is hearing loss the only damage which noise may produce—"nervous irritability, lessened capacity for work, palpitation and sleeplessness" have also been noted,[5] along with aural lesions.[5]

HEARING DAMAGE SHOULD BE PREVENTED

Prophylaxis of hearing damage is of the utmost importance, for "the treatment is completely unsatisfactory."[2] Actually, the problem is not one of easy solution. Devices such as ear plugs or helmets give some protection against low-pitched noise, but not against the more damaging high-frequency ones.[2]

A better solution is to eliminate the noise itself, as far as possible, or at least to deaden it. Rooms can be soundproofed. Machines can be cushioned, or placed on rubber mats.[2, 3] In short, the recent advances of acoustic engineering can be utilized. The expense involved is far less than that which well might be sustained by claims for occupational damage to hearing.

The physician has, too, a responsibility to employees under his care. It has been found in aviators that loss of hearing resulting from short flights may wear off in a few hours.[6] Recovery has also been noted in workers removed from a noisy environment, though "this does not mean that hearing necessarily returns to normal."[7] Since repeated damage may and probably will lead to permanent hearing loss, the physician might well advise a change of occupation for susceptible individuals. When there is permanent damage, mechanical aids to hearing may serve to rehabilitate the worker.

1. Ballenger, W. L. and Ballenger, H. C.: Diseases of the Nose, Throat and Ear. Lea & Febiger, Phila., 9th ed. 1947, pp. 808, 825.
2. Morrison, W. W.: Diseases of the Ear, Nose and Throat. Appleton-Century-Crofts, Inc., New York, 1948, p. 209.
3. Grove, W. E.: J. A. M. A. **140**: 674-677 (June 25) 1949.
4. Beasley, W. C.: Laryngoscope **50**: 856 (Sept.) 1940.
5. de Almeida, H. R.: Arch. Otolaryng. **51**: 215 (Feb.) 1950.
6. Ballenger, H. C.: A Manual of Otology, Rhinology, and Laryngology. Lea & Febiger, Phila., 3rd ed. 1947, p. 319.
7. Wheeler, D. E.: Arch. Otolaryng. **51**: 344 (March) 1950.

SONOTONE CORPORATION

ELMSFORD, NEW YORK

The psychosomatic series will be reprinted as a booklet; your postcard request now will bring it to you on publication

RED CROSS* ADHESIVE TAPE

all rolled up into one

NEW EXCLUSIVE FORMULA

greater freedom from skin irritation

sticks better

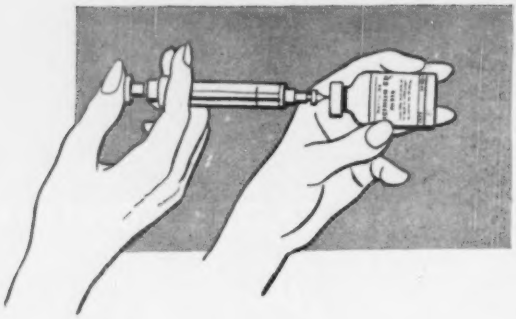
greater flexibility

lasting freshness

whiter appearance

Johnson & Johnson

* No connection whatever with the American National Red Cross



FOR

Rapid Therapeutic Action

CRYSTALLINE Penicillin G Sodium Merck, because of its prompt absorption after injection in aqueous solution, produces a rapid therapeutic effect. It is evident that this form of Penicillin is indicated where prompt action is desired, as in severe and fulminating infections.

It is unsurpassed in purity—suitable for all routes of administration—and extremely easy to handle.

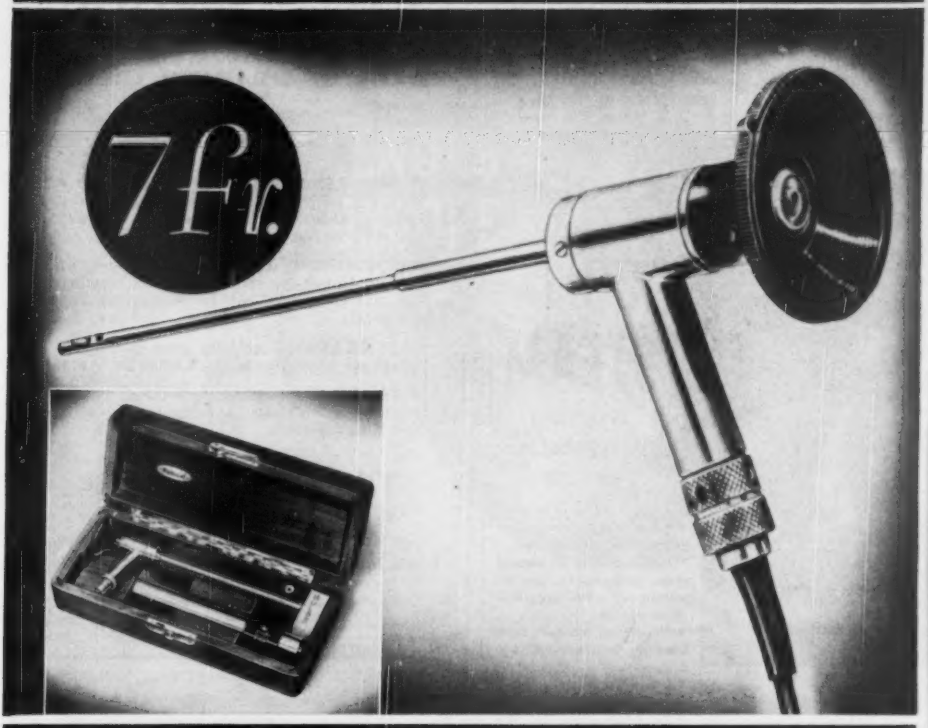
Literature is available upon request.

MERCK & CO., INC.
Manufacturing Chemists
RAHWAY, NEW JERSEY

Crystalline Penicillin G Sodium Merck

COUNCIL ACCEPTED

Never before so small for EUSTACHIAN INSPECTION



Ask for #5090 – National's Newest
NASOPHARYNGOSCOPE

Not only the newest but the **smallest** instrument of its kind . . . the companion to National's No. 5070 Nasopharyngoscope. Minute size makes it unequalled for examination of eustachian orifices in the very young and in patients having malformation of the bony structures. Like No. 5070, the **new No. 5090** incorporates National's exclusive Fontar Lens System for: **brighter, sharper** image; **wider field** of vision; an image **without distorting halo.** Hooded lamp can be replaced by user, eliminating customary return of instrument to factory for this replacement.

A valuable addition to your reference library — write for it today: "Post-Nasal Discharge."

Use coupon below.

National

ELECTRIC INSTRUMENT CO., Inc.
92-21 Corona Ave., Elmhurst, L. I., N. Y.

World-Famous Makers of Electro-Medical Instruments

National Electric Instrument Co., Inc. 2
Dept N., 92-21 Corona Ave., Elmhurst, L. I., N. Y.

☐ Send me my free copy of "Post-Nasal Discharge."

☐ Send me additional data on National's newest 7 Fr. Nasopharyngoscope No. 5090, as well as on the 11 Fr. Model No. 5070.

Name.....

Address.....

City..... Zone..... State.....

Walton HUMIDIFIER

accepted for

"COLD STEAM"

TREATMENT OF RESPIRATORY DISEASES

- Provides high humidities at normal room temperatures.
- High humidity at normal room temperature can be maintained while oxygen is administered.
- Eliminates danger from burning and undesirable dehydration.
- Offers a more comfortable atmosphere.
- Recommended in the latest medical text books.

USED IN LEADING HOSPITALS

4-Ways!

Leading medical authorities recommend and use Walton Humidifiers in treating croup and acute Laryngotracheobronchitis and their findings appear in the latest medical books. Walton Humidifiers are being supplied to leading hospitals throughout the country for use in oxygen tents, nurseries, cubicles, fog rooms, operating rooms and as vaporizers for direct inhalation. They induce no harmful dehydration, completely eliminate danger from steam burns or scalding, and assure more comfortable atmosphere. Walton Humidifiers are also available for use in professional offices and the home. For full details, please consult the booklets offered below.

*BIBLIOGRAPHY

Davison, F. W. — Acute Laryngotracheobronchitis. Archives of Otolaryngology. 47:455-464, April 1948.
Orten, H. B. — Acute Laryngotracheobronchitis. Archives of Otolaryngology. 33:926-960, June 1941.
Mitchell-Nelson—Textbook of Pediatrics. Fourth Edition. Pg. 747.
Morrison, William W., M.D. — Diseases of the Ear, Nose and Throat. Pg. 666, Diseases of Trachea and Bronchi. 1948.

Write for "HOSPITAL HUMIDIFICATION"

an authoritative brochure with complete information on hospital humidification. Literature on other Walton Humidifiers for office and residential use also available on request.

WALTON LABORATORIES
INCORPORATED
IRVINGTON 11, NEW JERSEY

SPECIAL SERVICES
for the
HARD OF HEARING ADULT

A HEARING AID CONSULTATION SERVICE to help in the selection of the hearing aid that is best suited to your patient's needs.

AUDITORY TRAINING to help your patient to get the most out of his hearing aid and to use all his remaining hearing efficiently.

LIP READING to help your patient to integrate what he sees with what he hears.

VOICE AND SPEECH WORK to help your patient retain pleasing tone quality and clear speech.

THE NITCHIE SCHOOL
OF LIP READING, INC.
Founded 1903
342 Madison Avenue, New York 17, N. Y.
Murray Hill 2-6423
Chartered by New York State Board of Regents

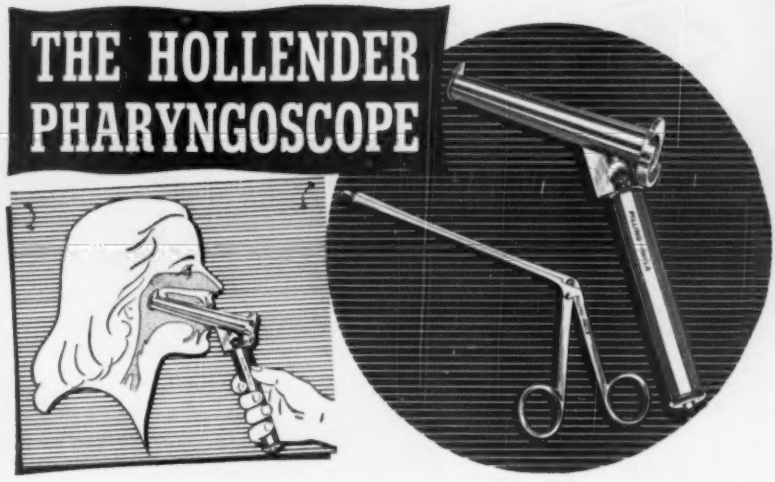
THE PARAVOX VERI-small "HOLLYWOOD" HEARING AID

Exceedingly small, lightweight, but powerful enough to compensate for extreme hearing losses. Thoroly tested for durability, moisture resistance, and ability to withstand shock! Thousands use and enjoy it. Nation-wide sales organization provides "one-minute" service. Accepted by Council on Physical Medicine and Rehabilitation, American Medical Association.

PARAVOX, INC.
2056 East 4th St., Cleveland 15, Ohio

Authentic Instruments for Otorhinolaryngology

THE HOLLENDER PHARYNGOSCOPE



Specialists in all fields of medicine look to Pilling for new and important instruments to facilitate therapeutic procedures and enhance diagnostic skill. Since 1814, leading surgeons and physicians have consulted Pilling—confident that Pilling craftsmen would create to their specifications precisely the instruments they desired.

Of special interest to the otolaryngologist is the Hollender Pharyngoscope, drawn *in situ* above. Designed for use in both diagnosis and treatment, this pharyngoscope is long enough for all oral cavities . . . provides a wide, unobstructed view of the nasopharynx. Placement is comparatively simple and retention is comfortable for long periods of time. Preliminary anesthesia is only occasionally required. Direct or indirect illumination may be used.

Shown with the Hollender Pharyngoscope is the Hartmann Extra-Long Punch, supplied with circular, oval or triangular bite. These punches feature the built-on basket for retaining punched-out tissue. The lumen of the pharyngoscope permits their ready passage.

HOLLENDER PHARYNGOSCOPE $45.00, BATTERY CORD $4.00 HARTMANN PUNCHES, STAINLESS STEEL $28.50 EACH

Order instruments direct from

George P. Pilling and Son Company

3451 WALNUT STREET
Philadelphia

A Standing Invitation:
When in Philadelphia, visit our new salesrooms. Free parking on our private lot.

INSTRUMENTS BY Pilling

PILLING FOR PERFECTION in surgical instruments

In allergic nasal and sinus disease, cosmetics are among primary contact irritants, especially face powder, cold cream, rouge, nail lacquer, mascara, wave set and eye shadow.[1]

In these cases, MARCELLE COSMETICS are important aids to the therapeutic armamentarium. MARCELLE COSMETICS are *the original hypo-allergenic cosmetics* and are formulated upon years of research in eliminating all known allergens or reducing them to a tenable minimum. Furthermore, MARCELLE COSMETICS enable the allergic patient to secure scientific protection without sacrificing esthetic appeal. For greater confidence for you and your patients, prescribe MARCELLE.®

1. Waldbott, G. L.: Management of Allergic Eczema. Am. Pract. 4:59-63 (Oct.), 1949.

MARCELLE COSMETICS, INC.

1741 North Western Avenue, Dept. O • Chicago 47, Illinois

Marcelle
HYPO ALLERGENIC
COSMETICS

COSMETICS ACCEPTED COMMITTEE ON COSMETICS **FOR SENSITIVE AND ALLERGIC SKINS**

CONTENTS

PAGE

Evaluation of the Operative Indications and Results in the Fenestration Operation for Otosclerosis. EDWARD H. CAMPBELL, M.D., PHILADELPHIA 513

The Maginot Line of Otology: Dependence on Antibiotics in Suppurative Middle Ear Disease; Facts and Fancies. FRANCIS L. LEDERER, M.D., CHICAGO 533

Antrochoanal Polyp. WALTER E. HECK, M.D.; OLAV E. HALLBERG, M.D., AND HENRY L. WILLIAMS, M.D., ROCHESTER, MINN. 538

N-Butanol: Its Use in Control of Postoperative Pain in Otorhinolaryngological Surgery. BERNARD WELT, M.D., BROOKLYN 549

Malar Bone Fractures. M. M. HIPSKIND, M.D., CHICAGO 565

Nasal Cavity of the Guinea Pig in Experimental Work. GEORGE KELEMEN, M.D., BOSTON 579

Management of Nasal Allergy. SOLOMON SLEPIAN, M.D., BROOKLYN 597

Fixation of the Vocal Cords in Acromegaly. JOHN K. GROTTING, M.D., AND JOHN DEJ. PEMBERTON, M.D., ROCHESTER, MINN. 608

Fenestration by Cold Fracture Method: Preliminary Report of an Improved Technic. SAMUEL ROSEN, M.D., NEW YORK 618

Surgical and Allied Diseases of the Salivary Glands and Ducts. WILLIAM G. ABEL III, M.D., NEW YORK 622

CASE REPORTS:

Aseptic Lateral Sinus Thrombosis. GOODLATTE B. GILMORE, M.D., AND ALAN AUSTIN SCHEER, M.D., NEW YORK 639

Death Following Tonsillectomy. G. W. TAYLOR, M.D., PHILADELPHIA 642

Congenital Malformation of the External Ear and Atresia of the Auditory Canal. GEORGE B. FERGUSON, M.D., AND CARL N. PATTERSON, M.D., DURHAM, N. C. 646

Meningitis, Pneumococcic Type 3; Mastoidectomy, Recovery. BENJAMIN H. SHUSTER, M.D., AND WILLIAM GORDON, M.D., PHILADELPHIA 650

NEWS AND COMMENT 654

ABSTRACTS FROM CURRENT LITERATURE 655

BOOK REVIEWS 667

DIRECTORY OF OTOLARYNGOLOGICAL SOCIETIES 670

THE ARCHIVES OF OTOLARYNGOLOGY is published by the American Medical Association to stimulate research in the field of otology and laryngology and to disseminate knowledge in this department of medicine.

Manuscripts for publication, books for review and correspondence relating to the editorial management should be sent to Dr. George M. Coates, Chief Editor, 1721 Pine Street, Philadelphia 3, or to any other member of the Editorial Board. Communications regarding subscriptions, reprints, etc., should be addressed, ARCHIVES OF OTOLARYNGOLOGY, American Medical Association, 535 North Dearborn Street, Chicago 10.

Articles are accepted for publication on condition that they are contributed solely to the ARCHIVES OF OTOLARYNGOLOGY. Manuscripts must be typewritten, preferably double spaced, and the original copy should be submitted. Zinc etchings and halftones will be supplied by the Association when the original illustrations warrant reproduction and when their number is not considered excessive.

Footnotes and bibliographies (the latter are used only in exhaustive reviews of the literature) should conform to the style of the *Quarterly Cumulative Index Medicus*. This requires, in the order given; name of author, title of article and name of periodical, with volume, page, month—day of month if the journal appears weekly—and year.

Matter appearing in the ARCHIVES OF OTOLARYNGOLOGY is covered by copyright, but as a rule no objection will be made to its reproduction in a reputable medical journal if proper credit is given. However, the reproduction for commercial purposes of articles appearing in the ARCHIVES OF OTOLARYNGOLOGY or in any of the other publications issued by the Association will not be permitted.

The ARCHIVES OF OTOLARYNGOLOGY is issued monthly. The annual subscription price (for two volumes) is as follows: domestic, $12.00; Canadian, $12.40; foreign, $13.00, including postage. Single copies are $1.25, postpaid.

Checks, money orders and drafts should be made payable to the American Medical Association.

OTHER PERIODICAL PUBLICATIONS
of the American Medical Association

THE JOURNAL OF THE AMERICAN MEDICAL ASSOCIATION—Weekly. Covers all the medical sciences and matters of general medical interest. Illustrated. Annual subscription price (three volumes): domestic, $12.00; Canadian, $13.50; foreign, $16.00. Single copies, 35 cents.

ARCHIVES OF INTERNAL MEDICINE—Monthly. Devoted to the publication of advanced original clinical and laboratory investigations in internal medicine. Illustrated. Annual subscription price (two volumes): domestic, $10.00; Canadian, $10.40; foreign, $11.00. Single copies, $1.00.

ARCHIVES OF NEUROLOGY AND PSYCHIATRY—Monthly. A medium for the presentation of original articles on nervous and mental diseases, with abstracts from foreign and domestic literature, book reviews, transactions of special societies, etc. Illustrated. Annual subscription price (two volumes): domestic, $12.00; Canadian, $12.40; foreign, $13.50. Single copies, $1.25.

ARCHIVES OF DERMATOLOGY AND SYPHILOLOGY—Monthly. Devoted to advancing the knowledge of and progress in cutaneous diseases and syphilis. Publishes original contributions on these two subjects, transactions of the important dermatologic societies, book reviews, etc. Illustrated. Annual subscription price (two volumes): domestic, $12.00; Canadian, $12.40; foreign, $13.50. Single copies, $1.25.

AMERICAN JOURNAL OF DISEASES OF CHILDREN—Monthly. Presents pediatrics as a medical science and as a social problem. Includes carefully prepared reviews, based on recent pediatric literature, abstracts from foreign and domestic literature, book reviews, transactions of special societies, etc. Illustrated. Annual subscription price (two volumes): domestic, $12.00; Canadian, $12.40; foreign, $13.50. Single copies, $1.25.

ARCHIVES OF SURGERY—Monthly. Devoted largely to the investigative and clinical phases of surgery, with monthly reviews on orthopedic and urologic surgery. Well illustrated. Annual subscription price (two volumes): domestic, $14.00; Canadian, $14.40; foreign, $15.50. Single copies, $1.25, except special numbers.

ARCHIVES OF OPHTHALMOLOGY—Monthly. Includes original articles on diseases of the eye, annual reviews of special subjects, book reviews, transactions of special societies, etc. Illustrated. Annual subscription price (two volumes): domestic, $12.00; Canadian, $12.40; foreign, $13.00. Single copies, $1.25.

ARCHIVES OF PATHOLOGY—Monthly. A periodical devoted to the publication of original articles and general reviews in the field of pathology. Illustrated. Annual subscription price (two volumes): domestic, $8.00; Canadian, $8.40; foreign, $9.00. Single copies, $1.00, except special issues.

ARCHIVES OF INDUSTRIAL HYGIENE AND OCCUPATIONAL MEDICINE—Monthly. Devoted to the advancement of knowledge of the diseases of industry and to the publication of scientific investigation in this field. Illustrated. Annual subscription price (two volumes): domestic, $8.00; Canadian, $8.40; foreign, $9.00, including postage. Single copies, $1.00.

QUARTERLY CUMULATIVE INDEX MEDICUS—A complete subject and author index to the worth while current medical literature of the world. Issued twice a year. Volumes bound for permanent reference. Subscription price, calendar year: domestic, $20.00; Canadian, $22.00; foreign, $22.00.

AMERICAN MEDICAL ASSOCIATION

535 North Dearborn Street **CHICAGO 10**

Entered as Second Class Matter Jan. 14, 1925, at the Postoffice at Chicago, Under the Act of Congress of March 3, 1879.

COPYRIGHT, 1950, BY THE AMERICAN MEDICAL ASSOCIATION

A. M. A.
ARCHIVES OF OTOLARYNGOLOGY
VOLUME 52 OCTOBER 1950 NUMBER 4
COPYRIGHT, 1950, BY THE AMERICAN MEDICAL ASSOCIATION

EVALUATION OF THE OPERATIVE INDICATIONS AND RESULTS IN THE FENESTRATION OPERATION FOR OTOSCLEROSIS

EDWARD H. CAMPBELL, M.D.
PHILADELPHIA

IN AN INVESTIGATION of the results obtained by the labyrinth fenestration operation for otosclerosis, an analysis may be made on the basis of the various factors commonly known to be important in determining the suitability of the patient for operation. When such factors are considered separately and the operative results studied, facts may be discovered that have a significant bearing. For instance, a comparison of the results obtained in a group of patients from 15 to 25 years of age with a group from 45 to 60 years of age may reveal certain features that have significance in the selection of patients for operation and in the prognosis.

The chief factors concerned in the selection of patients with deafness for the fenestration operation may be enumerated as follows:

1. Degree of deafness of the patient
2. Type of deafness present, as determined by the following means
   (a) air conduction audiometry
   (b) bone conduction audiometry
   (c) tuning fork tests
   (d) caloric tests
3. Condition of the tympanic membranes
4. Condition of the eustachian tubes
5. Age of the patient
6. Amount and type of tinnitus
7. Temperament and psychology of the patient
8. History of the development of the deafness
9. General condition of the patient

In this analysis an attempt will be made to group cases with operation into some of these selective factors and to evaluate the hearing results obtained.

Presented before the Pennsylvania Academy of Ophthalmology and Otolaryngology, May 12, 1950.

From the Department of Otolaryngology, Graduate School of Medicine of the University of Pennsylvania.

PREOPERATIVE DEGREE OF DEAFNESS

In the selection of otosclerotic patients for the fenestration operation it is important to consider carefully the amount of hearing impairment the patient has before operation. In general, the deafness should be of a degree that is handicapping to the patient but not so great but that a 30 decibel improvement with the operation would bring the hearing up to a serviceable level. This consideration means that, in general, the hearing should be impaired to about the 35 decibel level in the conversational frequencies before the patient should be considered for the operation. It also means that an average loss in the speech frequencies of more than 65 decibels would appear to contraindicate operation.

In general, the above may be considered true, but there are instances in which less loss of hearing than the 35 decibel level produces, in a certain patient, a handicapping degree of deafness, and a loss of more than 65 decibels may not be so great but that the patient's hearing can be brought to a practical and serviceable level. In the estimation of the degree of deafness factor, other features, such as the social and occupational demands of the patient, his psychological balance and his tinnitus, must be considered along with the amount of his hearing impairment.

An analysis of results in cases in these two groups—that is, a group with a hearing loss less than 35 decibels and a group with a hearing loss greater than 65 decibels—will reveal certain significant features. For the purpose of this analysis the selection of cases in these two groups will be made on the basis of a 38 or less decibel loss in the one group and a 62 or more decibel loss in the other group. The reason for this is that in no operators' series of cases are there any great number of patients operated on with an average loss of less than 35 decibels or an average loss of more than 65 decibels.

In my own series of cases with operation, a review,[1] from this degree of deafness standpoint, indicates that I had operated a year or more ago in 16 cases with an average loss of 38 decibels or less and in 22 cases with an average loss of 62 or more decibels.

Analysis of these cases shows the following results.

1. The average preoperative loss in the 16 cases with the comparatively mild deafness was 35.4 decibels.

2. The average postoperative loss in these 16 cases was 22.2 decibels.

3. The average improvement, therefore, in these cases was 13.2 decibels.

1. Campbell, E. H.: Analysis of Results Obtained in the Labyrinth Fenestration Operation for Otosclerosis, Arch. Otolaryng. **48**:666, (Dec.) 1948.

TABLE 1.—*Results Obtained in Patients Operated on With a Preoperative Hearing Loss of 38 or Less Decibels (Average of 512, 1024 and 2048 Frequencies)*

Case	Age	Average Decibel Loss Before Operation	Average Decibel Loss After Operation	Average Decibel Change	Time After Operation in Months
25	39	33	13	+20	18
49	23	36	20	+16	19
50	28	37	42	— 5	13
63	22	36	15	+21	17
68	25	36	38	— 2	15
69	23	36	20	+16	16
74	21	36	18	+18	15
77	20	37	10	+27	13
78	24	37	12	+25	12
89	26	33	33	0	12
98	24	36	37	— 1	12
56	24	30	15	+15	18
141	25	35	10	+25	13
145	23	35	22	+13	12
168	34	35	25	+10	24
218	27	38	25	+13	13

TABLE 2.—*Results Obtained in Patients Operated on With a Preoperative Hearing Loss of 62 or More Decibels (Average of 512, 1024 and 2048 Frequencies)*

Case	Age	Average Decibel Loss Before Operation	Average Decibel Loss After Operation	Average Decibel Change	Time After Operation in Months
57	53	63	45	+18	40
60	57	70	65	+ 5	15
80	49	68	53	+15	12
84	56	69	30	+39	36
87	49	62	70	— 8	12
99	59	62	35	+27	29
114	38	63	55	+ 8	24
117	40	68	55	+13	30
119	26	70	42	+28	18
125	37	63	22	+41	20
130	42	65	30	+35	24
135	56	68	68	0	24
144	32	83	85	— 2	18
148	28	67	47	+20	14
174	56	67	45	+22	13
192	27	62	42	+20	18
194	44	83	47	+36	12
201	31	72	50	+22	16
209	37	63	38	+25	14
210	47	63	43	+20	14
216	24	67	48	+19	14
219	45	63	23	+40	15

4. The number of unsuccessful cases—those in which there was not an improvement of 15 or more decibels—was 7.

5. The average age in the 16 cases was 25.6 years.

6. The average preoperative loss in the 22 cases with the severe deafness was 67.31 decibels.

7. The average postoperative loss in the 22 cases was 47 decibels.

8. The average improvement, therefore, in these 22 cases was 20.31 decibels.

9. The average age in the 22 cases was 41.22 years.

10. The number of unsuccessful cases—those in which there was not an improvement of 15 or more decibels—was 6.

Comment.—Although the number of cases is small in which this comparison is made of the results obtained in cases with comparatively mild deafness and in those with severe deafness, a definite trend is

TABLE 3.—*Comparison of Results Obtained With the Fenestration Operation in Patients With Mild Preoperative Deafness and in Patients With Severe Preoperative Deafness*

	Average Age	Average Decibel Loss Before Operation	Average Decibel Loss After Operation	Average Decibel Gain	Percentage of Cases with Successful Results	Average Decibel Gain in Cases with Successful Results	Average Decibel Gain in Cases with Unsuccessful Results
Patients (16) with preoperative loss of 38 or less decibels	25.6	35.4	22.2	13.2	56.3	29.33 (9 cases)	4 (7 cases)
Patients (22) with preoperative loss of 62 or more decibels	41.2	67.31	47.0	20.31	72.8	26.7 (16 cases)	2.6 (6 cases)

shown. The statistics indicate that the amount of improvement obtained in the mildly deaf patients is much less than the improvement obtained in the very deaf patients—13 decibels as compared to 20.1 decibels. The percentage of failure in the two groups is also significant. There were seven patients of the 16 mildly deaf patients who received less than a 15 decibel improvement; therefore, in 56.3 per cent the results were successful and in 43.7 per cent they were not. In the severely deaf group there were six patients who failed to receive 15 or more decibels of improvement. In the latter group, therefore, the results in 72.8 per cent were successful and in 27.2 per cent they were not.

At this point an explanation of what may and may not be considered failure is needed. In reporting results of the fenestration operation there has been expressed a difference of opinion by various authors on what may be considered success in such cases of operation. Some authors have contended that an improvement of 15 or more decibels over the preoperative level may be considered a success irrespective of the level of the hearing preoperatively. Others have maintained that the

hearing after operation must be brought to the 30 decibel level or better without consideration of the preoperative hearing before the results can be called successful.

There is a great deal more to consider than these two contentions in order to designate the results in a given case as successful or unsuccessful. Any therapeutic measure that can improve hearing 15 decibels or more can be considered to be at least a technical success, but such a 15 decibel improvement may be useless to the patient if it brings the hearing only from a 65 decibel loss to a 50 decibel loss. On the other hand, an improvement of hearing from a 50 decibel loss to a 35 decibel loss (average for conversational frequencies) gives a decided help to the patient, and the operation will usually be considered successful by him.

In the mildly deaf group, a 15 and often a 10 decibel improvement may bring the hearing to a serviceable level that is very beneficial to the patient. For instance, an improvement from a 35 decibel loss to a 25 decibel loss makes a great difference in practical hearing. This was shown in three of the cases analyzed above (cases 145, 168 and 218).

In these three cases the improvement was as follows: case 145, from a preoperative average of a 35 decibel loss to a postoperative average of a 22 decibel loss (13 decibel improvement); case 168, improvement from a 35 decibel loss to a 25 decibel loss (10 decibel change), and case 218, improvement from a 38 decibel loss to a 25 decibel loss (13 decibel change).

In the analysis above, the results in these three cases were considered unsuccessful because there was not an improvement of 15 or more decibels. All the patients, however, are greatly pleased with the result of the operation and considered it a complete success. If these three cases are removed from those in the mildly deaf group in which the results are considered unsuccessful, the rate of failure in this group would be reduced to four (out of the 16), giving a percentage of success in this group of 75.

There is another type of case in which the results may be considered successful when a study of the audiograms at first seem to indicate a complete failure. It is the not uncommon case that will show improvement after operation only to the 2048 frequency or perhaps to the 1024 and 2048 frequencies, while the loss at 512 may be so great that the average is brought down below the 35 decibel loss. If the 2048 frequency is brought to a 20 decibel level, even though the other frequencies are more than a 40 decibel loss, the patient has a distinct improvement in practical hearing.

In further analysis of these 22 cases in which there was a preoperative loss of 62 or more decibels, a few interesting and significant features, which follow, are discovered.

1. Most of the patients are in the age group of 40 years or more.

2. In spite of the more advanced age of the patients, however, the improvement that may be obtained is more than that in the younger group.

3. Few such patients are brought to hearing better than the 30 decibel level.

4. An improvement of 40 or more decibels in the conversational range may be obtained in some of these cases.

5. While many patients do not receive sufficient improvement to be of practical benefit, some patients are greatly pleased with an improvement to the 35 to 45 decibel level.

6. There is a greater improvement to the low frequencies than to the middle ones.

7. In neither of these two groups are the best results obtained so far as average decibel gain is concerned. The much larger group of cases with preoperative loss between 39 and 62 decibels gives the greater gain in hearing after operation and the larger percentage of success. The results in this larger group are not analyzed at this time.

AGE IN SELECTION OF PATIENTS

That the age of the patients is a factor which might influence their suitability for the fenestration operation has been speculated on by various authors. Some operators have felt that the younger person will have a better chance of obtaining and retaining satisfactory improvement of hearing than the patient past middle age. It is well known that, generally speaking, otosclerosis is a young person's disease. Most of the cases start during the teens or twenties, but frequently the hearing impairment has not reached a handicapping degree or possibly even been noticed until in the third or fourth decades of life.

In general, it can be assumed that the young person with otosclerosis will not have had the condition long enough for it to have advanced to a severe degree and perhaps make him unsuitable for operation. At times, however, a severe deafness is found in the very young person, and it is quite possible that the disease may be so rapidly progressive as to make the patient unsuitable for operation even in his teens. The youngest patient that I operated on, a girl aged 14, had an average preoperative hearing loss of 55 decibels to the conversational frequencies. Her operative indications were good, however, and she obtained a satisfactory improvement of hearing with the operation. Some operators have made it a rule to avoid operating on patients past 45 years of age, assuming that their indications for the operation are, in general, not good and that the results are not sufficiently good. While it is true that the greater proportion of the younger otosclerotic patients is suitable for the operation, the older patient, when found to have suitable operative indications, obtains just as good a result.

In a study of my cases in which I operated longer than one year ago, I have separated them into two groups for the purpose of comparison of the age factor. One group is composed of 48 patients from

14 to 26 years of age. The other group consists of 32 patients aged 45 or older. An analysis of these two groups shows the following results.

Patients aged from 14 to 26 (48)

1. The average age was 21.8 years.
2. The average hearing loss before operation was 43.87 decibels.
3. The average hearing loss after operation was 27.16 decibels.
4. The average improvement of hearing was 16.7 decibels. This average includes those cases in this series with failure.
5. On the basis of success representing an improvement of 15 or more decibels of hearing, the results in 32 of the 48 were successful and in 16 they were not.
6. The average improvement of hearing in the 32 successful cases was 23.5 decibels.
7. The average improvement of hearing in the 16 unsuccessful cases was 4.8 decibels.

Patients from 45 to 58 years (32)

1. The average age was 49.8 years.
2. The average hearing loss before operation was 55.1 decibels.
3. The average hearing loss after operation was 38.66 decibels.
4. The average improvement of hearing was 16.46 decibels. This average includes those cases in this series which were unsuccessful.
5. On the basis of success representing an improvement of 15 or more decibels of hearing, in 23 the results were successful and in nine cases they were not.
6. The average improvement of hearing in these 23 successful cases was 22.1 decibels.
7. The average improvement of hearing in the nine unsuccessful cases was 2 decibels.

Comment.—An interesting feature of the analysis in this series of patients in the two age groups is that the average gain in hearing of each of the groups is almost exactly the same—16 decibels. In both groups these averages include the unsuccessful cases, and this inclusion, of course, reduces the amount of gain received in the successful cases.

In the older group some of the patients had profound preoperative deafness, but these as well as the others in this group had retained sufficient auditory nerve function to make them suitable for operation although not classified as ideal candidates. In the younger group all the patients can also be classified as suitable, most of them being in the ideal classification.

Another rather surprising feature of the analysis is the practically equal but comparatively small gain in hearing received in the successful cases in the two groups—23.5 decibels in the younger group and 22.1 decibels in the older group. It might be supposed that the young patients with ideal operative indications would receive the greatest amount of hearing improvement with the operation. Two patients of the younger group received an improvement to the 10 decibel level (average for 512, 1024 and 2048 frequencies), but improvement to

TABLE 4.—*Results Obtained in Patients Operated on Aged 25 or Younger*

Case	Age	Average Decibel Loss Before Operation	Average Decibel Loss After Operation	Average Decibel Change	Time After Operation in Months
3	23	47	17	+30	24
9	20	59	28	+31	23
13	22	50	62	−12	12
14	20	40	23	+17	22
22	16	46	20	+26	23
30	25	41	10	+31	12
37	20	39	37	+ 2	18
45	23	45	15	+30	22
49	23	36	20	+16	19
51	21	42	26	+16	12
56	24	39	15	+15	18
60	22	49	27	+22	15
61	25	39	15	+24	15
63	22	36	15	+21	17
68	25	36	38	− 2	15
69	23	36	20	+16	16
72	19	46	45	+ 1	23
74	21	36	18	+18	15
76	24	38	33	+ 5	13
77	20	37	10	+27	13
78	24	37	12	+25	12
93	24	53	13	+40	12
96	23	44	13	+31	12
98	24	36	37	− 1	12
109	23	40	22	+18	10
129	23	43	33	+10	24
131	24	48	35	+13	24
133	22	53	27	+26	18
136	22	42	35	+ 7	12
139	20	43	17	+26	27
141	25	35	10	+25	12
142	23	50	57	− 7	13
145	25	35	17	+18	12
149	22	43	33	+10	14
154	23	42	25	+17	14
173	24	53	22	+31	13
172	21	48	26	+22	22
176	25	47	32	+15	22
178	23	48	52	− 4	22
181	19	43	35	+ 8	10
190	16	48	18	+30	6
198	14	55	35	+20	16
207	23	38	18	+20	17
215	14	43	17	+26	15
221	21	53	33	+20	14
233	19	50	48	+ 2	9
240	20	48	37	+11	10
241	22	60	52	+ 8	8

TABLE 5.—*Results Obtained in Patients Operated on Aged 45 or Older*

Case	Age	Average Decibel Loss Before Operation	Average Decibel Loss After Operation	Average Decibel Change	Time After Operation in Months
12	47	51	22	+29	23
21	49	52	25	+27	20
41	48	38	23	+15	40
42	45	43	28	+15	16
43	48	49	34	+15	16
57	53	63	45	+18	40
58	47	82	50	+32	12
66	57	70	65	+ 5	15
80	49	68	53	+15	12
84	56	69	30	+39	36
87	49	62	70	— 8	12
92	49	44	22	+22	12
97	52	41	25	+16	12
120	50	52	42	+10	21
135	50	68	68	0	24
137	45	58	26	+32	18
140	51	52	48	+ 4	22
153	52	48	42	+ 6	14
161	45	53	27	+26	20
165	52	52	47	+ 5	24
174	56	67	45	+22	18
186	50	53	38	+15	20
187	49	52	35	+17	18
196	48	52	52	0	17
199	56	57	28	+29	17
208	46	47	32	+15	17
210	47	63	43	+20	14
219	45	63	23	+40	13
220	46	48	33	+15	13
223	46	40	23	+17	10
224	50	47	30	+17	13
230	51	60	65	— 5	2

TABLE 6.—*Comparison of Results Obtained with the Fenestration Operation in Patients Aged 26 or Younger and in Patients Aged 45 or Older*

	Average Age	Average Decibel Loss Before Operation (512, 1,024, 2,048)	Average Decibel Loss After Operation (512, 1,024, 2,048)	Average Decibel Gain	Percentage of Cases with Successful Results	Average Decibel Gain in Cases with Successful Results	Average Decibel Gain in Cases with Unsuccessful Results
Patients (48) aged from 14 to 26.....	21.8	43.87	27.16	16.71	66.66	23.5 (32 cases)	4.8 (16 cases)
Patients (32) aged from 45 to 58.....	49.78	55.1	38.66	16.44	71.87	22.1 (23 cases)	2 (9 cases)

below the 15 decibel level was unusual. One patient of the younger group received an average improvement of 40 decibels, but this patient, although only 24 years of age, had a severe preoperative deafness.

What explanation can be found to account for the comparatively little improvement of hearing obtained in the younger group? In a recent report of the results obtained in 100 consecutive cases with operation,[1] I found, in the analysis of the cases, that in the 63 patients who had successful results the average improvement was 25.93 decibels, about 2.5 decibels more than the improvement obtained by the group in the ages from 14 to 26 years and about 4 decibels more than the improvement obtained in the age group of 45 to 58 years. This result would seem to indicate that the amount of improvement in hearing is greater in the group aged 26 to 45 than it is in a group younger than 26 or in a group older than 45.

That this situation should be so has some logical background. The average decibel loss before operation in the young group will always be less than in any older group chiefly for the reason that the young patient has not had the condition long enough (on the average) to have progressed to a severe hearing loss. The oldest group will always have the greatest preoperative hearing loss (on the average) because the otosclerotic condition has been present for many years and has advanced to a severe hearing loss. Furthermore, in the latter group there is more apt to be present some auditory nerve deterioration that, on the average, would lessen the amount of improvement that the patient can obtain. These features are borne out in the two groups here reported. The average preoperative loss in the young group was 43.9 decibels and in the older group was 55.1 decibels.

It might be still argued that the young group should receive more decibel gain in hearing than the 25.9 average decibel improvement I obtained in consecutive fenestration cases of no particular age group. However, this is not logical and hardly seems possible, for it would mean that the hearing in the young group would be improved to an average of 15 or 16 decibel loss. An average at this level means that in many individual cases there must be an improvement to practically normal hearing, and that is probably not possible in a fenestrated patient. It is not reasonable to suppose that the substitute conduction mechanism created by the fenestration operation can approach that close in efficiency to the elaborate conduction apparatus nature has built in the human ear.

The analysis made in those cases with a preoperative hearing loss of less than 39 decibels substantiates the above impression, that is, the improvement of the hearing after operation in those cases of mild deafness is not nearly so great as in the cases with fenestration as a whole or in the older group separately. In my series the improvement

of hearing in the 16 cases which averaged a preoperative hearing loss of 35.8 decibels was only 12.5 decibels. This improvement was sufficient to bring the postoperative hearing average to a 23.3 decibel loss, which gives the patient excellent hearing but does not closely approach the normal.

Deductions that may be drawn from such analyses as presented above are as follows:

1. The patient with a 35 decibel average loss of hearing should not be expected to improve with the operation to an extremely good level. In the occasional instance he may improve to the 10 decibel level but is more apt to improve to about the 20 to 23 decibel level, which gives him excellent hearing. These patients are very satisfactory to operate on because even a little improvement brings them up to a level of practical hearing.

2. The patient with a severe preoperative hearing loss (more than a 60 decibel average loss) also is apt to receive only a moderate improvement (20 decibels), which, in the majority of instances, will be of little or no help to him. However, if such a patient is tested carefully and found to have normal or near normal auditory nerve function at the level of the three speech frequencies, he stands just as good a chance of obtaining hearing to a practical level as patients of any age.

3. Occasionally, spectacular improvement is obtained in the profoundly deaf patients (40 or more decibels), which gives complete rehabilitation.

4. On the average, the greatest amount of hearing improvement is obtained in those patients with a preoperative loss of 40 to 55 decibels and in the age group of 26 to 45.

5. Technically, there is a higher percentage of success (15 or more decibel improvement) obtained in the group older than 45 than in the youngest group, but there is a higher percentage in the youngest group that obtain hearing to a practical and serviceable level.

ANALYSIS OF CASES FROM STANDPOINT OF BONE CONDUCTION

It has been the custom among fenestration operators, in selecting the cases for operation, to consider bone conduction hearing the measurement of the auditory nerve function. While there are other methods that help to distinguish conductive deafness from perceptive deafness, the measurement of bone conduction in a deaf person is the best means available of estimating his auditory nerve function. It must be kept in mind, however, that there exist at times conditions that will make bone conduction hearing obscure and tend to give a false interpretation of the type of hearing loss.

The factor probably most commonly present is tinnitus. Severe tinnitus near the pitch of the 1024 or 2048 frequencies may block reception of the audiometric tones of these frequencies, both by air and by bone conduction, to such a degree that the patient may give the audiometric curve of a perception deafness when in reality he has a conduction deafness. Such tinnitus will not infrequently mask the reception of the 2048 frequency so that a considerable loss is registered by bone

conduction at this level (2048), and the patient may be thought to have auditory nerve degeneration at that level when he actually has normal or near normal nerve function. The same consideration applies to the 1024 frequency, but probably to a less extent.

It has been my experience to find an occasional patient who will have a considerable loss of hearing by air and bone conduction at the 1024 level and better hearing by air and bone conduction at the 2048 level. In such cases measurement of the level of the patients' tinnitus has revealed it to be near the 1024 frequency. While it masked to some extent the reception of this audiometric frequency, it did not interfere with the reception of the 2048 frequency to the same degree and therefore permitted better hearing to the 2048 frequency than to the 1024. If auditory nerve degeneration had been present at the 1024 level it quite likely would be present at those frequencies above it, and the hearing therefore at 2048 (especially by bone conduction) would not have registered better than at 1024.

I wish here to analyze a group of cases with fenestration as regards the results obtained, especially at the 2048 frequency level, in connection with the preoperative bone conduction to 2048. I have separated the patients into two groups, the members of one group all having a preoperative bone conduction audiometric reading of 15 or less decibels at the 2048 level, and the second group having a preoperative bone conduction reading of 30 or more decibels at the 2048 level. I have considered that a bone conduction loss of as much as 15 decibels at the 2048 frequency would indicate little if any deterioration of the auditory nerve elements at that level, while a loss of 30 or more decibels to the 2048 frequency might indicate a distinct impairment of the nerve function at that level, with the assumption that the tests are done by an experienced tester with masking when indicated.

By comparing the improvement of hearing to the 2048 frequency in these two groups after fenestration, I had expected to observe significant changes. It might be expected that the postoperative improvement to the 2048 frequency when the bone conduction was within normal limits would be materially better than the postoperative hearing at the 2048 frequency in those cases in which the preoperative bone conduction was reduced 30 or more decibels. The results of such an analysis are somewhat surprising.

In the group with preoperative bone conduction reading of 15 or less decibels (essentially normal) there are 45 patients operated on. These patients were unselected, but two cases have not been included because they resulted in complete failure from the start, owing to injury of the membranous labyrinth. The results tabulated are not all judged a year or more after operation since it was not thought necessary in this particular analysis. If the case was successful so far as improved hear-

ing was concerned six weeks after operation it was not important with relation to the preoperative bone conduction whether in this case part or all of this improvement was subsequently lost or remained successful past the one or two year period. The preoperative bone conduction would have no influence on the healing reaction or postoperative bone regeneration that might eventually cause the case to result in failure.

The results of the analysis of this group are as follows.

1. The average age of these 45 patients was 31.

2. The average decibel loss to the speech frequencies (512, 1024 and 2048) before operation was 47.4.

3. The average loss to the 2048 frequency before operation was 43.3 decibels.

4. The preoperative bone conduction loss at the 2048 level averaged 11.2 decibels.

5. The average decibel loss to the speech frequencies (512, 1024 and 2048) after operation was 23.48.

6. The average loss to the 2048 frequency after operation was 18.77 decibels.

7. The average improvement of hearing after operation at the 2048 frequency was 24.55.

In the group with preoperative bone conduction loss of 30 or more decibels there are 43 patients operated on. As in the other group, these patients are unselected except that three patients in the consecutive cases with operation are not included because complete failure resulted from causes having nothing to do with the preoperative bone conduction. Again, as in the previous group, the postoperative hearing in these 43 patients is not necessarily the final one or two year result. The essential feature of this particular analysis is comparison of the best results obtained after operation in the two groups, the one group indicating normal bone conduction at the 2048 level, and the other group representing bone conduction at this same level materially reduced from normal.

The results in this second group can be listed as follows.

1. The average age of these 43 patients operated on was 35.3.

2. The average decibel loss to the speech frequencies (512, 1024 and 2048) before operation was 55.

3. The average loss to the 2048 frequency before operation was 55 decibels.

4. The preoperative bone conduction loss at the 2048 level averaged 34.4 decibels.

5. The average decibel loss to the speech frequencies (512, 1024 and 2048) after operation was 33.28.

6. The average loss to the 2048 frequency after operation was 33.95 decibels.

7. The average improvement of hearing after operation at the 2048 level was 21 decibels.

Comment.—In the comparison of the above two groups of cases with operation, it has been rather surprising to discover that the average improvement of hearing in these cases with poor bone conduction at the 2048 frequency is almost as good as in those cases with normal bone conduction at the same frequency—21 decibels as compared to 24.5. The

TABLE 7.—*Results Obtained With the Fenestration Operation in a Group of Patients With a Preoperative Bone Conduction Loss at the 2048 Frequency of 15 Decibels or Less (Essentially Normal Bone Conduction)*

Case	Age	Average Decibel Loss Before Operation (512, 1,024 and 2,048)	Average Decibel Loss at 2,048	Bone Conduction Loss at 2,048	Average Decibel Loss After Operation (512, 1,024 and 2,048)	Average Decibel Loss After Operation at 2,048	Average Decibel Change at 2,048
145	25	35	25	10	22	20	+ 5
146	28	45	30	5	17	15	+15
147	41	58	55	10	15	10	+45
152	52	48	50	10	30	15	+35
155	38	45	35	5	12	10	+25
160	37	57	55	10	45	45	+10
167	34	50	40	15	45	35	+ 5
168	34	35	25	5	25	20	+ 5
180	20	67	45	15	28	15	+30
181	19	63	35	5	22	15	+20
188	33	43	40	10	13	10	+30
190	16	48	45	10	15	10	+35
195	37	52	50	15	17	15	+35
204	33	48	45	10	27	20	+25
206	23	53	50	10	28	25	+25
207	23	38	35	10	18	15	+20
208	46	47	40	10	32	25	+15
209	27	63	65	15	38	40	+25
211	35	50	50	10	22	20	+30
212	30	45	40	15	25	20	+20
213	26	47	40	10	38	25	+15
215	14	43	40	5	17	15	+25
218	27	38	30	15	25	20	+10
221	21	53	50	10	33	20	+30
224	30	47	40	10	30	25	+15
225	30	48	40	10	20	20	+20
227	20	48	45	15	22	25	+20
242	33	42	45	15	22	30	+15
243	29	50	50	15	25	20	+30
255	29	60	65	15	32	25	+40
258	21	50	40	15	28	25	+15
260	18	47	45	10	17	10	+35
261	19	47	50	15	17	10	+40
265	26	45	40	10	20	15	+25
266	32	47	45	10	25	20	+25
268	46	53	50	5	18	15	+35
270	44	60	60	10	23	20	+40
273	28	43	35	10	22	20	+15
280	47	28	30	15	17	10	+20
284	23	47	40	10	15	10	+30
289	20	50	50	10	17	10	+40
290	29	50	45	15	23	15	+30
296	42	50	50	15	27	20	+30
298	31	43	35	15	17	10	+25
299	22	37	25	10	15	10	+25

TABLE 8.—*Results Obtained With the Fenestration Operation in a Group of Patients With a Preoperative Bone Conduction Loss at the 2048 Frequency of 30 or More Decibels*

Case	Age	Average Decibel Loss Before Operation (512, 1,024 and 2,048)	Average Decibel Loss at 2,048	Bone Conduction Loss at 2,048	Average Decibel Loss After Operation (512, 1,024 and 2,048)	Average Decibel Loss After Operation at 2,048	Average Decibel Change at 2,048
148	28	67	65	40	35	35	+30
156	30	58	55	35	28	20	+35
174	56	67	65	35	37	30	+35
177	28	53	50	30	40	45	+ 5
178	23	48	50	35	52	55	— 5
187	49	52	50	40	27	30	+20
194	44	83	80	50	47	50	+30
195	40	48	45	30	35	35	+10
244	38	56	55	35	45	45	+10
210	47	62	50	30	43	45	+ 5
216	34	67	70	45	33	30	+40
219	45	63	65	30	23	10	+55
226	35	53	65	45	30	40	+25
193	28	58	60	35	27	25	+35
159	36	52	55	30	22	30	+25
165	52	52	50	30	22	25	+25
166	29	48	50	30	27	30	+20
171	24	53	45	30	22	20	+25
179	43	53	60	30	32	35	+25
206	29	60	55	35	35	30	+25
214	28	50	50	30	27	15	+35
220	46	47	45	30	33	45	0
223	46	40	40	30	23	25	+15
228	40	55	60	40	72	55	+ 5
234	28	55	50	30	30	25	+25
238	36	48	45	30	23	20	+25
239	41	50	55	40	63	60	— 5
240	20	48	55	30	37	40	+15
246	?	57	60	30	28	30	+30
252	37	55	60	30	33	40	+20
256	25	62	60	40	28	30	+30
257	50	78	70	40	38	45	+25
262	48	57	65	40	30	30	+35
263	24	50	50	30	23	20	+30
264	39	50	45	40	35	40	+ 5
271	32	63	65	40	23	30	+35
272	33	50	45	35	28	45	0
274	33	53	65	35	27	35	+30
279	29	45	45	30	28	30	+15
282	36	47	40	30	20	15	+25
283	38	50	55	30	30	40	+15
297	30	63	60	40	48	35	+25
298	41	40	40	30	42	45	— 5

TABLE 9.—*Comparison of Results Obtained with the Fenestration Operation in Patients Whose Bone Conduction at the 2048 Frequency Before Operation Was Essentially Normal and in Patients Whose Bone Conduction at the 2048 Frequency Before Operation Was 30 or More Decibels*

	Average Age	Average Decibel Loss Before Operation (512, 1,024, 2,048)	Average Decibel Loss Before Operation at 2,048	Average Bone Conduction Loss at 2,048	Average Decibel Loss After Operation (512, 1,024, 2,048)	Average Decibel Loss After Operation at 2,048	Average Decibel Gain at 2,048
Patients (45) with preoperative bone conduction loss of 15 or less decibels at 2,048 frequency...	31	47.4	43.33	11.22	23.48	18.77	24.56
Patients (43) with preoperative bone conduction loss of 30 or more decibels at 2,048 frequency..	35.3	55.0	55.0	34.41	33.28	37.95	21.05

expectation had been that the group with much reduced bone conduction at 2048 would receive much less improvement at this level after operation because of the assumption that this lowered bone conduction represented reduced auditory nerve function (at this level) and, therefore, less response at this level would be anticipated.

What explanations can be advanced for the comparatively good improvement the patients with poor bone conduction obtained? The following possibilities may be considered: (1) The tests were inaccurately done; (2) the associated tinnitus masked the reception in those cases with poor bone conduction (at 2048), and (3) bone conduction tests at 2048 frequency are, at best, inaccurate and do not represent true auditory nerve function at this level.

In regard to the possibility that the tests were inaccurately performed, it can be stated that the tests were made by a trained tester in the standard accepted manner in a soundproofed room with a masker used in the untested ear. The bone conduction readings were always compared with the estimated tuning fork readings, and if any inconsistency was observed all tests were repeated. Whenever the patient showed an emotional disturbance or was not in a mood for accurate response the tests were repeated on subsequent days. The testing instrument was considered as accurate as any such instruments are, considering the various factors of error that enter into the testing of bone conduction, especially to the higher frequencies. The audiometer was frequently calibrated for both air and bone conduction with known normals, and in every case the tuning fork tests were checked with the audiometric readings.

A careful analysis of the tinnitus pitch and intensity in all of these cases was not made. If it had been done it seems undoubtedly true that in many cases it would have been found that the masking effect of the tinnitus was responsible for the apparently poor bone conduction at the 2048 frequency. In some of the cases the tinnitus was measured, and in two or three instances it was thought to be a factor in masking reception of the 2048 frequency. However, it was more frequently discovered that the tinnitus was nearer the 1024 level and interfered with the reception of this tone more than it did with the 2048 frequency.

As previously remarked, the bone conduction was found in several instances apparently reduced 20 to 30 decibels to the 1024 frequency, probably owing to masking with tinnitus, and found normal or very near normal to the 2048 frequency. A high pitched tinnitus so near the 2048 frequency that a masking effect is produced at the tone level is very apt to be connected with auditory nerve deterioration, which alone would produce a lowering of bone conduction at that frequency. Therefore, a patient with high pitched constant type of tinnitus might

be expected to show reduced bone conduction at the 2048 level from two causes, the nerve deterioration at that level and the masking effect of the tinnitus.

In clinical practice it is the common observation that patients respond more readily and apparently more accurately to the bone conduction tests at the low and middle frequencies than they do at the 2048 and 4096 frequencies. The high frequencies are not transmitted well through bone, and it is probable that the many variations in the texture and development of the mastoid process interfere more and cause more variations with the transmission of tones at the 2048 frequency and above than they do with the transmission of tones at the 1024 level and below.

In many cases of otosclerosis, even in the advanced ones, there is less air conduction loss to the 2048 frequency than to any of the frequencies below. This condition would tend to give a less accurate bone conduction reading at the 2048 frequency than at the frequencies below. The deafer the patient is to a given frequency, provided the deafness is of a pure conduction type, the greater should be his response to bone conduction, in general. An otosclerotic patient, therefore, with an average of a 55 decibel loss to the low frequencies including 1024 who has a 35 decibel loss to 2048 may not give as accurate a response to the latter frequency as he does to those below. It is possible in some instances that in such a case the patient may be hearing the tone more by air conduction than by bone conduction. It has been my practice in testing bone conduction with the 2048 tuning fork to have the patient block his ears tightly with his fingers. This should give him at least a 50 decibel deafness of the conduction type, while his air conduction loss (without the ear being blocked) may have been only 30 to 35 decibels. With the ears firmly blocked, if the patient hears the tuning fork on his mastoid process to an estimated normal degree it can be assumed that he has no auditory nerve deterioration at that level. Taking everything into consideration, the accuracy of bone conduction tests at 2048 and above can be questioned, and the poor readings at 2048 level may not necessarily indicate nerve degeneration and a poor prognosis for improvement of hearing at that level in an otosclerotic patient.

In the analytic comparison of the results of the two groups, as shown in the table, it will be noted that the average age of the group with poorer bone conduction was about four years more than that of the group with normal bone conduction. In general, the older patient with otosclerosis will have the more advanced condition and will be expected to have some auditory nerve involvement.

It is further noted in the table that the group with poor bone conduction at 2048 showed a 55 decibel loss on the average before operation, while the other group with normal bone conduction showed a

47.5 decibel loss before operation. With the greater loss before operation, on the whole, there is less improvement than in the group with the lesser loss. This consideration applies to the 2048 frequency in particular, as it is shown that the group with the poor bone conduction at 2048 had an average loss of 12.3 decibels more by air conduction at the 2048 frequency than did the group with normal bone conduction. This alone might well be responsible for the 4.5 decibel less improvement of the group with poor bone conduction than that of the other group.

It will again be noted that in the group with poor bone conduction (at 2048) the postoperative hearing has not been brought up to a good serviceable level (33.13), while the other group has been improved to the 23.5 decibel level, which gives excellent practical hearing. This situation may be attributed partly to the high average air conduction loss before operation and partly, perhaps, to the high bone conduction loss representing nerve deterioration.

It must be taken into consideration in this analysis that the average postoperative improvement at the three speech frequencies in each group is practically the same as it is for the 2048 frequency alone. This similarity would appear to indicate that in spite of the materially reduced bone conduction of 2048 of the one group the improvement of hearing at this 2048 level is practically as much in that group as it is for the average of the three speech frequencies. It has not been recorded here but it can be stated that the bone conduction in all the cases of both groups was normal for the 512 frequency and only slightly reduced in a few of the cases for the 1024 frequencies. Therefore, the improvement obtained at the 512 and 1024 frequencies with the bone conduction normal at those levels is no greater than the improvement in hearing for the 2048 frequency with the preoperative bone conduction for that frequency reduced 34.5 decibels.

All this analysis of these two groups appear to indicate, therefore, that the apparently considerably reduced bone conduction at the 2048 level has caused only a mild affect on the postoperative results—a difference of approximately 3.5 decibels of hearing. It would seem that there should be more difference if the 34.4 decibel bone conduction loss at 2048 represents a proportionate degree of auditory nerve degeneration. It is more logical to believe that the 34.4 decibel bone conduction loss is not a true indication of auditory nerve dysfunction at this level but represents a combination of factors influencing bone conduction that are not well understood. The conclusion that might be drawn from such an analysis, therefore, is that considerably reduced bone conduction at the 2048 level does not necessarily give a bad prognosis so far as the results of the fenestration operation are concerned.

SUMMARY AND CONCLUSIONS

An analysis of results obtained with the fenestration operation in cases of otosclerosis has been attempted from three following standpoints:

(*a*) The degree of deafness before operation

(*b*) The age of the patient

(*c*) The bone conduction before operation

Two groups of patients operated on are compared from the standpoint of their deafness before operation. One group is composed of 16 patients with a mild preoperative loss of hearing—an average of 38 or less decibels. The other group is composed of 22 patients with a severe preoperative hearing loss—an average of 62 or more decibels.

The average improvement of hearing in the 16 mildly deaf patients was 13.2 decibels.

The average improvement of hearing in the 22 severely deaf patients was 20.3 decibels.

The analysis indicated that the amount of improvement obtained in the mildly deaf patients is much less than the improvement obtained in the severely deaf patients.

Other interesting features are observed and discussed in the comparison of these two groups.

Patients operated on have also been placed into two groups for comparison of the results from the standpoint of the patients' age. One group is composed of 48 patients from 14 to 26 years of age, and the other group consists of 32 patients 45 years of age or older.

The average improvement in hearing in the 48 patients of the younger group was 16.7 decibels. This computation included 16 patients who were considered to have unsuccessful results, inasmuch as they received less than 15 decibels of improvement. The average improvement in the 32 successful cases was 23.5 decibels.

The average improvement in hearing in the 32 patients of the older group was 16.46 decibels. This computation included nine patients who were considered to have unsuccessful results. The average improvement in the 23 successful cases was 22.1 decibels.

It is significant that the hearing improvement after operation was practically the same in the two groups. Other features of significance were also noted in comparison of the two groups, and explanatory comment is made on the comparatively little improvement obtained in the younger group of patients.

It was observed that there is a higher percentage of success obtained in the group older than 45 years of age than in the group younger than 25 years, but there is a higher percentage of patients in the younger group that obtain hearing to a practical and serviceable level.

An analysis of a third series of cases with operation was made from the standpoint of the preoperative bone conduction at the 2048 frequency.

This series consisted of two groups, the members of one group all having a preoperative bone conduction loss of 15 or less decibels at the 2048 frequency (essentially normal bone conduction), and the second group having a preoperative bone conduction loss of 30 or more decibels at the 2048 frequency. A comparison of the postoperative results were made in these two groups.

The average improvement at the 2048 frequency in the 45 patients with normal bone conduction (at the 2048 level) was 24.55 decibels.

The average improvement at the 2048 frequency in the 43 patients who had a bone conduction loss (at the 2048 frequency) of 30 or more decibels was 21 decibels.

It was thus observed that the improvement in hearing was almost as good in those cases with poor bone conduction (at 2048) as it was in those cases with normal preoperative bone conduction (at 2048), 21 as compared to 24.5 decibels.

Speculation is made on the reasons for this comparison. It seemed probable that tinnitus near the pitch of the 2048 frequency masked the reception of the audiometric tone in some cases. It seemed probable also that a combination of factors that are not well understood could influence the bone conduction at 2048 to give a reading that is not truly representative of the auditory nerve function at this level.

A conclusion that might be drawn, therefore, is that a considerably reduced bone conduction at the 2048 frequency level does not necessarily indicate auditory nerve degeneration at that level and does not necessarily give a bad prognosis so far as the results of the fenestration operation are concerned.

133 South Thirty-sixth Street.

THE MAGINOT LINE OF OTOLOGY

Dependence on Antibiotics in Suppurative Middle Ear Disease; Facts and Fancies

FRANCIS L. LEDERER, M.D.
CHICAGO

THIS IS a jet-propelled age in which epoch-making strides bring about an ever changing scene. Even before the printer's ink dries, extolling the virtues of some newly discovered antibiotic, another in vitro experiment is in line to offer even greater promise of conquering diseases which up to then have been medical enigmas. The advent of each successive chemotherapeutic or antibiotic agent gives rise to mixed emotional reactions among all physicians, no less the otologist. Some physicians treat the new agent like that of an intruder in their midst, a threat to the very existence of a rather well established modality in a specialty, and they resist the very application of the proved agent. The other extreme is represented by a group of physicians who give up the thorough, though time-consuming, history-taking and careful study of the patient and indiscriminately and fearlessly dose the patient.

Such promiscuousness in therapy is frequently wasteful of material; a mask for the true basic clinical facts; purely empirical when not based on previously proved organism sensitivity, and a malevolent camouflage for long-standing irreversible or progressive disease states. The French sat out a "phoney" war in complete faith of the invulnerability of a well conceived line of defense. There is a Sedan (where the German breakthrough occurred) in the otologic line of defense just as there was in the Maginot line.

Until now, we physicians have tended to compensate for the lack of diagnosis in certain instances by giving all the antimicrobial drugs at once. "Combined" therapy, i. e., the concurrent administration of two antimicrobial drugs for the treatment of a single infection, has in mind the postponement or prevention of predominance of drug-resistant microorganisms. Penicillin is acknowledged as a prophylactic agent of significant magnitude, but it is obvious that common sense must obtain. Certain principles of practical chemotherapy have been well established. The present tendency to treat undiagnosed fevers and ailments with

---

From the Department of Otolaryngology, University of Illinois College of Medicine.

Presented before the Pennsylvania Academy of Ophthalmology and Otolaryngology, May 13, 1950, Bedford Springs, Pa.

penicillin and other antimicrobial agents is haphazard, and the results are usually unsatisfactory. In general, the chemotherapeutic agents are more effective in controlling established infections than in preventing them.

One can be thankful that penicillin has a low toxicity,[1] is bacteriostatic at low concentrations and is an active bactericidal in high concentrations (except against most gram-negative organisms and higher forms of pathogenic organisms). Whenever the system is saturated with penicillin, the resulting rate of killing organisms attains maximal speed and cannot be superseded by any further increase in concentration of penicillin in the medium. Insufficient dosage will lower the effective level. What is required is to produce promptly at the site of infection an optimal concentration of penicillin and to maintain continuously that concentration until the organisms present have been eradicated. More recently, procaine penicillin and either the sodium or the potassium salt of penicillin G, have been combined in a 3 to 1 ratio. One cubic centimeter of this material (containing 400,000 units), commonly carried in a water suspension, provides the advantages of high initial peak concentrations of penicillin in the blood, levels of at least 1.0 unit per cubic centimeter with the maintenance of significant concentrations, above 0.04 unit per cubic centimeter for 24 or more hours. Organisms susceptible to low concentrations respond to a single daily dose of these combined soluble and insoluble salts of penicillin and provide adequate antimicrobial protection. For highly susceptible organisms it is feasible to give large doses at widely separated intervals.

We in otolaryngology are the gadgeteers of medicine. Therefore, the various topical, local and aerosol methods have given rise to many types of instruments and modalities. Aerosolization, nasal inhalation and instillation, lozenges, troches, ointments and ear drops have had their share of individual supporters. The control over any infection is to provide sufficient amounts of the antimicrobial agent at the site of the inflammation. This is done to best advantage by attaining and maintaining adequate blood levels. Sufficient topical levels do not, a priori, produce therapeutic results. Today, more than ever before, it is imperative that we establish a precise etiological, pathological diagnosis in every infection of the middle ear. Consequently, prominent among our greatest needs at present are better and more exact technics for etiological diagnosis. Antibiotics should not be employed as diagnostic tools; they are not to be substituted for thinking and for relieving a suppurative focus.

1. With the wide employment of penicillin, allergy to it is not uncommon, and its symptoms of fever, urticaria, arthralgia, stomatitis and other manifestations may be severe. However, few deaths have been reported. These deaths resulted usually from exfoliative dermatitis, but the nephropathy and polyarteritis observed with the use of the sulfonamides are practically unknown with the use of penicillin. I have observed large bullous lesions from head to foot not unlike the exfoliative dermatitis seen during arsenical therapy for syphilis.

Admittedly, the discharging ear has become less of a menace in its acute stage because of the employment of antibiotics and chemotherapeutic agents and as a result of more widespread knowledge of good mastoid surgery. There is, however, a warning to be sounded, namely, that these agents must yet be tested under conditions of an epidemic and especially with a "lozenged" public indiscriminately dosed with these agents so that in the time of need for action they will offer but little response.

In other words, there seems to be little justification for the current enthusiasm in regard to penicillin when used locally and orally. The increasing numbers of angry red, extremely sore throats from the local "prophylactic" use of this agent attests to its possible hazards and abuse. Its prolonged administration under such conditions may produce resistant strains of organisms which will fail to respond to therapy at some future time when the effect is sorely needed. It is obvious that when suppuration supervenes, adequate surgical drainage becomes a must. The employment of antimicrobial agents does not permit the violation of sound principles of surgical procedure but constitutes exceedingly important supportive measures.

Furthermore, chronicity can develop and subsequent intracranial complications of otogenic complications may occur, having been made possible by total antibiotic complacency and dependency. Giving up careful inspection of the picture of the tympanic membrane and supplying drainage from the middle ear make necessary too many radical operative mastoid procedures.

The treatment of acute otitis media has not changed. Virulency of the invading organism and the basic mechanical problems of the cavum tympani and the eustachian tube are the same. The majority of middle ear infections of this day that respond to antimicrobial agents are the very same types (otitis media simplex) which responded to the magic of phenol-glycerine drops; the ears treated today are the very same ears for which exaggerated claims were made that they "drained by way of the eustachian tube." The most humane and the best protection against future suppurative chronicity and adhesive process leading to varying degrees of deafness is still a well performed incision of the tympanic membrane. Then, and then only, should the antimicrobial therapy be instituted on the basis of organism-sensitivity, sufficient concentration in contact with the infecting microbes and in such amounts as to destroy them over an adequate period of administration.

Recognition of the physical, social and economic potentialities of a discharging ear leads to the objective of restoring the patient to normalcy without jeopardizing his hearing efficiency or endangering his life. Chemotherapeutic and antibiotic aids have, unfortunately, led to a complacent attitude. The basic principles applying to chronic aural suppuration have not been changed by these newer modalities, and there is still

a need for urgent care of acute middle ear suppuration. Antibiotics have been credited rather enthusiastically with the curtailment of mastoid complications. While this is true to some extent, their use has, nevertheless, allowed many patients to be carried beyond the stage of surmounting the threat of acute inflammation without, however, completely avoiding the possible ravages of chronic suppuration, with its handicapping, life endangering and even death-dealing possibilities. There are, of course, other local and general factors which allow and even predispose an ear to chronicity besides those embodied in the lack of proper treatment. Inherent anatomic configurations, the influence of infectious fevers, the type of invading organisms, the presence of nasopharyngeal and sinus disease and the site of the tympanal perforation all have a bearing on whether or not and why an aural suppuration becomes chronic.

The physician must attitudinize his thinking to the importance of the minutiae of tympanic membrane changes. The site of the perforation does have a bearing on the clinical course, the treatment and the prognosis of the case at hand. Modern literature becomes flooded with claims of the value of local instillation of antibacterial drops. Generally speaking, 85 per cent of chronic cases of suppurative otitis media clear up under use of most any favorite therapy. It is the cholesteatomatous or tuberculous process which may not respond. Mere application of antimicrobial material on the surface of an inflammatory lesion will not necessarily reach the invading organism or alter the basic pathological change. This fact is particularly true in the ear in which there is excessive drainage or unduly large amounts of secretions in fibrinous exudates and in deep-seated areas with tiny, draining fistulas.

The grouping of chronic forms of suppurative otitis media is based on Lillie's classification of the perforation site. Group I comprises those cases which have the following characteristics: tubal perforation (anterior-inferior quadrant); intermittent, recurring thin or mucoid, odorless discharge; related to allergic states and repeated upper respiratory states, nasopharyngeal and paranasal sinus disease. Its treatment is directed to elimination of infections so prominently associated with it; proper blowing of the nose (with both nostrils wide open); careful cleansing of the ear, utilization of capillary suction; tubal inflations; use of ear drops consisting of nonaqueous solutions (alcohol) and abstention from such activities as swimming. The necessity for mastoid surgery is not likely in this form of suppuration.

Group II is the type in which the disease is more or less confined to the middle ear; mucopurulent secretion, which is persistent; a central perforation, which is so variegated as to be pinpoint or occupies the entire membrana tensa (kidney bean shape) and with the presence of granulations or polyps. The treatment is essentially the same as in group I. In addition, chemical cauterization of granulations and the cautious snaring of polyps is carried out.

In group III there is a marginal or attic perforation; caries of the ossicles; granulation tissue or polyps; the presence of cholesteatoma, with a scanty fetid discharge. The hearing in such cases is usually good. When medical and local therapy proves to be inadequate, an endaural tympanomastoidectomy may be performed, preserving the hearing. When the hearing loss is severe and the pathological change is extensive, a complete radical mastoidectomy is indicated.

In group IV the otologist is concerned with such findings as characterize group III, except that there is evidence of extension of the disease to the labyrinth, lateral sinus, meninges, brain and facial nerve. It is essential that mastoid surgery be performed to prevent the further extension of the infection and to combat the various types of complications.

Experience reemphasizes the fact that the significance of acute exacerbations of latent and chronic middle ear suppuration must be appreciated by the alert otologist. The presence of all or a few of such signs as sudden deafness, tinnitus and dizziness; sudden increase in discharge, which is seen to pulsate; sharp pains in the ear; a cyanotic, edematous tympanic membrane; hyperemic middle ear mucosa; mastoid symptoms and biopsy findings of the polyp may point to an acute exacerbation, a menacing specter to the patient as well as to the otologist who confidently portrays the role of medical bystander.

Especially in cholesteatoma, he is like the mariner navigating through iceberg-infested waters, for that which is visible to his eye is not nearly so critical as that which is beyond his visual field. Need for surgical intervention is apparent, aided greatly by employment of antimicrobial therapy. In the treatment of labyrinthine involvement, the mastoid operation is performed as indicated. The labyrinth is opened only if there are symptoms and signs of intracranial extension (meningitis). The present attitude is engendered because of the knowledge that the labyrinth has a tendency for spontaneous healing and, furthermore, because the antibiotic therapy offers a more certain prevention of a leptomeningitis. In the treatment of the latter condition, after the suppurative focus has been eradicated, antimicrobial therapy has written an amazingly successful chapter. Brain abscess, too, becomes an area of greater conquest, and improved statistics have resulted. We do not subscribe, however, to the intrathecal introduction of penicillin. In lateral sinus phlebitis, surgical procedure, antibiotics and the use of dicumarol and heparin sodium offer combined formidable forces in dealing with the local and systemic effects of the disease.

1853 West Polk street.

ANTROCHOANAL POLYP

WALTER E. HECK, M.D.
Fellow in Otolaryngology and Rhinology, Mayo Foundation
OLAV E. HALLBERG, M.D.
AND
HENRY L. WILLIAMS, M.D.
ROCHESTER, MINN.

THE SO-CALLED antrochoanal polyp, rising from the antral mucosa, has appeared to be clinically different in character from the usual nasal polyp although grossly similar in appearance.

One of us (H. L. W.)[1] stated that the antrochoanal polyp seemed different to him for the following reasons: 1. Many of the antrochoanal polyps appear to arise from a small area of mucosa on the posterior superior wall of the affected antrum. 2. Often the choanal polyp is the only example of polypoid change occurring on either side of the nose, and, not infrequently, when the affected antrum is opened the stalk of the polyp is the only evidence of such change in the mucosa. 3. If the polyp is grasped in the nose or in the nasopharynx and avulsed, it frequently recurs, still maintaining its solitary character. 4. Nasal polyposis, in general, appears to be associated with symptoms and signs of an allergic state.

In cases of antrochoanal polyps, frequently neither history nor findings suggestive of the presence of an allergic state can be obtained. It was felt, therefore, that study of the antrochoanal polyps removed at the Mayo Clinic might throw some light on the subject.

REVIEW OF THE LITERATURE AND COMPARISON OF OUR FINDINGS WITH THOSE OF OTHERS

Historical Data.—Killian,[2] in 1906, was the first to recognize the true site of origin of the antrochoanal polyp. Prior to this time it had

From the Section on Otolaryngology and Rhinology, Mayo Clinic.

Read at the meeting of the Mississippi State Medical Association, Jackson, Miss., May 9, 1950.

1. Williams, H. L.: Fundamental Changes of Concepts in Regard to Chronic Suppurative Sinusitis, Arch. Otolaryng. **47**:695-697 (May) 1948.

2. Killian, G.: The Origin of Choanal Polypi, Lancet **2**:81-82 (July 14) 1906.

been assumed that all choanal polyps arose in the choanal area. Killian found that many of them arose in the maxillary antrum of Highmore because of his observation that their pedicles protruded through the antral ostia. "The accessory antral ostium in such cases," he stated, "is usually large, being 1.7 cm. to 2.2 cm. in diameter." Killian apparently made these observations without actually opening an antrum to demonstrate the antral origin. He reported 21 cases. His mode of treatment was snare avulsion, pulling the pedicle from the ostium. The antrochoanal polyp, therefore, is often given the eponym "Killian polyp."

Ino Kubo is credited with being the first to open the antrum in this condition.[3]

Incidence.—Reports in the literature suggest that antrochoanal polyps are relatively rare. Syme [4] reported that 26, or about 3 per cent, of 878 patients with antral disease had choanal polyps. Salinger, in discussing a paper by Morwitz,[3] stated that only a few patients who have antrochoanal polyps are encountered in a lifetime of medical practice. Myers [5] reported that in 25,000 ear, nose and throat examinations made over a period of three years in the United States Army during World War II, he observed only three patients who had antrochoanal polyps.

Of 1,720 patients who were given a diagnosis of nasal polyps (used as an inclusive term) at the Mayo Clinic in a ten year period (1938 through 1947), 56 definitely appeared to have antrochoanal polyps. Eight additional patients probably had this condition, but the records are not entirely clear on this point. If these eight are added, a total of 64 cases of antrochoanal polyps (3.7 per cent of the entire number of patients) is obtained.

Age and Sex.—In the literature emphasis has been placed on the occurrence of antrochoanal polyps in children,[6] and Rupilius [7] reported the case of a child 3 years old who had such a lesion.

The ages of the 64 patients in our series are listed in table 1. Seven patients were less than 13 years of age, and six were in the seventh

3. Morwitz, S. M.: The Solitary Choanal Polypus, Illinois M. J. **59**:213-216 (March) 1931.

4. Syme, W. S.: Choanal Polypus, J. Laryng. & Otol. **31**:515-518 (Dec.) 1916.

5. Myers, D.: Obstruction of the Nasopharynx Secondary to Choanal Polyp of Antral Origin: Report of 3 Cases, Arch. Otolaryng. **44**:328-333 (Sept.) 1946.

6. (*a*) Voorhees, I. W.: Large Postnasal Polyp in Child, Arch. Pediat. **50**: 367-368 (May) 1933. (*b*) Laff, H. I.: Deforming and Recurring Polyps of Youth, Arch. Otolaryng. **30**:795-799 (Nov.) 1939. (*c*) Michaelis, A.: Nasal Polypi in an Eight-Year-Old Child: Case Presentation, Laryngoscope **38**:776-777 (Dec.) 1928.

7. Rupilius, K.: Ein Choanenrandpolyp beim Kleinkinde, Arch. f. Kinderh. **94**:209-210, 1931.

decade of life. Between these extremes of age there was a surprisingly uniform distribution.

There were 41 male and 23 female patients, or, roughly, a ratio of 2:1.

Location.—In our series the site of origin of the polyp in the antrum could not be ascertained. The antrochoanal polyps occurred with approximately equal frequency on the two sides (table 2). One patient was stated to have bilateral antrochoanal polyps, but definite antral origins were not satisfactorily described by the surgeon. The latter patient was one of 10 who had more than the one polyp. The nasal polyps associated with the antrochoanal polyp in each case were of minor degree.

TABLE 1.—*Age Distribution of 64 Patients Who Probably Had Antrochoanal Polyps*

Age by Years	Number of Patients
1-9	2
10-19	7
20-29	13
30-39	10
40-49	9
50-59	11
60-69	6

TABLE 2.—*Location of Antrochoanal Polyp*

Type of Polyp	Left Side	Right Side	Both Sides
True antrochoanal polyp	30	26	...
Probably true antrochoanal polyp	4	3	1 (?)
Total	34	29	1

Unusual antrochoanal polyps have been reported by Dawson,[8] Voorhees[9a] and Shea.[9] Shea reported the case of a youth 17 years old who had an antrochoanal polyp that hung down into the mouth and was half the size of the tongue. Because he was "strangled" by the mass while vomiting, it was removed by transantral operation.

Wishart[10] stated that the base of the antrochoanal polyp is usually on the back wall of the antrum or the outer wall near the back. Ewing[11] and Davis[12] reported the usual site to be near the antral ostium.

8. Dawson, G. W.: A Case of Antro-Choanal Polypus of Exceptional Size, Lancet **1**:1095-1096 (June 3) 1922.

9. Shea, J. J.: A Report of 2 Intranasal Angiomas, and an Unusually Large Antral Polyp, Tr. Am. Laryng., Rhin. & Otol. Soc. **36**:465-472, 1930.

10. Wishart, D. J. G.: The Origin of the Naso-Antral Polyp, Canad. M. A. J. **6**:7-11 (Jan.) 1916.

11. Ewing, T.: Antro-Nasal or Choanal Polypus: A Clinical and Pathological Report of 35 Cases, J. Laryng. & Otol. **33**:227-234 (Aug.) 1918.

12. Davis, E. D. D.: Some Nasal Conditions, Brit. M. J. **1**:1167-1168 (May 28) 1938.

Allergy.—In the literature on antrochoanal polyps no mention is made of a possible association with allergy. Much has been written, however, about the possible role of allergy in the etiology of ordinary nasal polyps. Fraser [13] cited the early observation of Uffenorde that bronchial asthma was a frequent complaint in cases of nonsuppurative sinusitis.

Duke,[14] in 1927, in discussing allergy, reported that 24 per cent of 500 patients who had perennial allergy had nasal polyps, as did 10 per cent of patients who had seasonal allergy.

Thereafter, Kern and Schenck,[15] in a series of papers, gave emphasis to the allergic factor in the pathogenesis of nasal polyps. They pointed out the high incidence of polyps among persons who had allergy (and, conversely, the low incidence among nonallergic persons) and the high incidence of family histories of allergy among persons with nasal polyps. In their opinion, better therapeutic results were obtained by combining treatment for allergy with surgical procedure. They stated that of 50 persons with asthma, inspection indicated that 34 had nasal polyps. Others have reported comparable findings.[16]

Walsh and Lindsay,[17] in 1934, disagreed with Kern and Schenk. They studied 75 patients who had nasal polyps. The 44 who reacted positively to skin tests rarely had pus in the nose on inspection, and microscopic examination of the polyps removed from the 44 patients showed many eosinophils. On the other hand, the remaining 31 patients, who reacted negatively to skin tests, usually had pus in the nose, and primarily segmented granulocytes (polymorphonuclear leukocytes) and lymphocytes were seen on microscopic examination of the polyp. They felt, therefore, that nasal polyps could arise from an infectious as well as an allergic process. Williams, however, classified the second type as hyperplastic sinusitis and stated the belief that the infection was

13. Fraser, R. H.: Non-Suppurative (Nasal) Sinusitis and the Principles of Hirsch (Vienna), Bull. Battle Creek Sanitar. & Hosp. Clin. **24**:36-49 (March) 1929.

14. Duke, W. W.: Allergy as Related to Otolaryngology, Ann. Otol., Rhin. & Laryng. **36**:820-828 (Sept.) 1927.

15. Kern, R. A., and Schenck, H. P.: Allergy a Constant Factor in the Etiology of So-Called Mucous Nasal Polyps, J. Allergy **4**:485-497 (Sept.) 1933; Importance of Allergy in Etiology and Treatment of Nasal Mucous Polyps, J. A. M. A. **103**:1293-1298 (Oct. 27) 1934; The Diagnosis and Treatment of Mucous Nasal Polyps, with a Consideration of the Allergic Factor, M. Clin. North America **22**:1633-1643 (Nov.) 1938.

16. Kelley, S. F.: The Incidence of Sinusitis and Nasal Polypi in Bronchial Asthma, Laryngoscope **46**:692-698 (Sept.) 1936. Jensen, A. P.: Polypous Nasal Sinus Affections and Allergy, Acta oto-laryng. **30**:440-451, 1942.

17. Walsh, T. E., and Lindsay, J. R.: Cytology of Nasal Polypi, Arch. Otolaryng. **20**:649-658 (Nov.) 1934.

secondary to a primary allergy. He pointed out that the absence of positive reactions to skin tests did not abolish the possibility of an allergic etiology. Hansel [18] found that in allergic coryza secondary infection will produce a neutrophilic leukocytosis overshadowing the previous eosinophilia.

In analyzing the records of our 64 patients, we found that 15 (23.4 per cent) had one or more positive indications that an allergic factor might be present. The criteria used to indicate an allergic factor were as follows: (1) a history of an apparent allergic disease, either present or past; (2) a family history positive for allergic disease; (3) positive reactions to skin tests, and (4) the presence or absence of abnormal eosinophilia. The presence of more than 4 per cent eosinophils on differential count of the blood was considered positive for eosinophilia.[19]

The various combinations of these criteria specifically noted in the case records in this series of cases are given in table 3. Of bearing on

TABLE 3.—*Allergic Criteria in Antrochoanal Polyps*

	Results of Test													
	On 15 Patients with Positive Criteria									On 49 Patients with Negative Criteria				
Criteria of Allergy														
Allergic disease, concomitant or in past history	+	—	—	+	+	—	—	+	—	—	—	—	—	—
Family history of allergic disease	+	+	—	..	+	+	—	—	+	—	..	—	—	..
Skin test results	..	..	+	+	+	—	..	+	+	..	..	—	..	..
Blood eosinophilia present	..	—	..	..	+	..	+	..	—	..	..	..	—	—
Patients	4	2	2	2	1	1	1	1	1	34	6	5	2	1

allergy also is the result of microscopic study of tissue eosinophilia made in our 64 cases. These cases will be reported with the microscopic changes.

Roentgenographic Examinations.—Of our 64 patients, 61 had undergone roentgenographic examination of their sinuses. The result of one examination was reported as negative. Thirty-five (57.4 per cent) gave evidence suggestive of a unilateral lesion, corresponding with the site of the polyp found on operation (table 4). Six of these 35 examinations the roentgenologist reported as revealing definite lesions. On one, he made a definite diagnosis of polyp while on another he gave as accurate a description as one might desire, stating that there "appears to be a mass extending into the nose from the antrum."

The roentgenologic diagnosis in a third case was cyst or polyp; in two cases it was tumor, and in one, a cyst or granuloma.

18. Hansel, F. K.: Allergy of the Nose and Paranasal Sinuses: A Monograph on the Subject of Allergy as Related to Otolaryngology, St. Louis, C. V. Mosby Company, 1936.

19. Best, C. H., and Taylor, N. B.: The Physiological Basis of Medical Practice, ed. 4, Baltimore, Williams & Wilkins Company, 1945.

In addition to these six reports of a definite lesion by the roentgenologist, the surgeon made note of another roentgenogram in which shadows indicated bilateral polypoid hyperplasia to the roentgenologist, but the surgeon made a diagnosis of a definite polyp arising in one antrum.

It is probably likely that the surgeon, by correlating the history and clinical findings with the roentgenogram, could come to a more specific diagnosis than the roentgenologist could.

TABLE 4.—*Results of Roentgenologic Examination of Patients Who Had Antrochoanal Polyps*

		Cases
No examination		2
Results negative		1
Evidence suggesting unilateral lesion		35
Opacity of involved antrum	9	
Thickened membrane of antrum	8	
Thickened membrane of antrum and polyp	1	
Diffuse cloudiness of antrum	5	
Diffuse cloudiness of antrum and tumor in antrum	2	
Diffuse cloudiness of antrum, mass into nose from antrum	1	
Possible cyst	2	
Possible cyst or polyp	1	
Possible cyst or granuloma	1	
Diffuse dulness of antrum	2	
Homogeneous dulness of antrum	2	
Soft tissue mass in left side of nose; sinuses normal	1	
Evidence of bilateral involvement		25
Thickened membrane of antrums or other sinuses or both	9	
Pansinusitis with thickened membrane	5	
Polypoid hyperplasia	4	
Polypoid hyperplasia (polyp noted by surgeon)	1	
Opacity of antrums	2	
Pansinusitis	2	
Cloudiness of ethmoid sinuses	1	
Thickened membrane of frontal and ethmoid sinuses	1	
Total		64

Thus in seven (11.4 per cent) of 61 patients, a definite tumor or mass was demonstrated by roentgenogram.

SURGICAL TREATMENT

Fifty-nine of our 64 patients received surgical treatment for antrochoanal polyps at the clinic. Five did not receive surgical treatment.

The various procedures used and the number of recurrences are given in table 5. The antrochoanal polyps recurred in 20.3 per cent of the 59 cases in which polypectomy was performed at the clinic.

Recurrences followed in approximately 5.5 per cent of cases in which the external approach was used and in 28.2 per cent of the cases in which avulsion or removal through an antrum window was employed.

GROSS AND HISTOLOGIC APPEARANCE AND COMPARISON OF NASAL POLYPS WITH ANTROCHOANAL POLYPS

Antrochoanal polyps were studied microscopically by Killian,[2] who declared that they "hardly differ" from ordinary nasal polyps. Crowe [20] similarly stated that they differ only in location and size.

Tissue removed at operation from 54 of our 64 patients was available for microscopic study. The gross specimen was available for study in 50 of the 54 patients.

For comparison, sections of nasal polyps from an equal number of patients who had ordinary nasal polyps were taken at random from a large series of such cases. In 51 of these 54 cases, the gross specimen happened to be available.

Gross Appearance.—Specimens from 26 of the 50 patients with antrochoanal polyp appeared grossly to be a single, large polyp; 24 specimen bottles contained multiple pieces of tissue, this condition

TABLE 5.—*Recurrences of Antrochoanal Polyps in Relation to and Surgical Approach for Polypectomy*

Surgical Approach	Patients	Recurrences
External operation on antrum	18	1
Antrum window	26	7
Avulsion in hospital	13	4
Avulsion in office	2	0
Total	59	12

probably being due to piecemeal removal. Only two of the 51 specimens of nasal polyps appeared grossly to be single, large polyps.

Twenty-five of the antrochoanal polyps had a definite constriction or stalk, indicating the connection between antral and choanal portions (figure). None of the specimens of nasal polyps had this characteristic.

These gross specimens were observed in a fixative solution. Of the antrochoanal type, 31 had retained the typical shiny, skinned-grape appearance of polyps. Nineteen had a granular appearance. The solution in six of the bottles had turned a deep brownish black. Thirty-nine of the specimens of nasal polyps had the shiny, glistening appearance, and 12 were granular. In seven of the bottles containing nasal polyps the solution had turned a dark brownish black, probably due to old blood.

In 17 of the bottles containing antrochoanal polyps there were additional nondescript fine shreds of tissue. Only three of the bottles of nasal polyps contained additional shreds of tissue.

20. Crowe, S. J.: The Nose, chap. 3, in Lewis, D.: Practice of Surgery, Hagerstown, Md., W. F. Prior Company, Inc., 1948, vol. 4, pp. 1-76.

Although the volumes of gross tissue in the bottles were crudely estimated, generally showing more tissue in the antrochoanal specimens, such estimates could not be considered to indicate reliably the actual volume removed because usually, after removal of a number of nasal polyps from a patient, only a representative specimen was sent for pathologic examination.

Microscopic Appearance.—As stated before, tissue was available for microscopic study in 54 cases of antrochoanal polyp and in 54 cases of nasal polyps. Generally, the sections of antrochoanal polyps were of greater size than were those of the nasal polyps. The average greatest diameter of the antrochoanal polyps was 20.1 mm., while that of the nasal was 16.3 mm.

Typical antrochoanal polyp.

The microscopic sections in eight of the cases of antrochoanal polyps showed the constriction or stalk joining the antral and nasochoanal portions. None of the sections of the tissue from the 54 patients who had nasal polyps showed this feature. Seven of the nasal polyps, however, showed a definite pedicle, and two showed the suggestion of a pedicle.

The epithelium of nasal polyps is commonly of the so-called respiratory (schneiderian) type, a pseudostratified ciliated columnar epithelium such as lines the nasal chambers and sinuses.

Of the specimens of the antrochoanal group, 45 were covered with respiratory epithelium; four appeared to have been covered with a respiratory type of epithelium, but large areas had sloughed away; one had respiratory epithelium, but most of it was torn away from the

polyp proper; two were covered with a stratified squamous epithelium, in one of which it was mixed with areas of a low columnar epithelium. In one of this group the epithelium was so degenerated as to make its identification impossible. In another, no epithelium was visible.

The epithelium of 40 of the specimens of nasal polyps was of the respiratory type. Five additional specimens of this type showed large sloughed areas. Four others of this group had respiratory epithelium of a deteriorated appearance, with a degeneration of many of the cells. In three specimens the entire epithelium had apparently sloughed away. Another had only bits of epithelium, indistinguishable as to type. One was covered with a stratified squamous epithelium.

Cilia: The cilia showed up very poorly on the sections or tissue in this series. This poor appearance was disappointing. In sections from antrochoanal polyps showing respiratory epithelium, only 4 had cilia of good appearance; in 20 they were fair; in 20 they were poor, and in the remaining 6 cilia were practically absent. Of the group of 49

TABLE 6.—*Comparison of Number of Goblet Cells and Depth of Basement Membrane of Antrochoanal Polyps and of Nasal Polyps*

		Grade				
	Polyp	0-1	1	2	3	4
Goblet cells	Antrochoanal	34	13	2	0	0
	Nasal	25	10	14	2	3
Basement membrane	Antrochoanal	7	21	13	5	5
	Nasal	10	18	20	4	2

nasal polyps with respiratory epithelium, 1 had excellent cilia; 4 had good cilia; 13 were fair; 20 were poor, and 2 had practically no cilia.

Goblet Cells and Basement Membrane: The number of goblet cells observed were roughly and arbitrarily graded 0 to 4, none to maximum. Obviously, the lowest number was found in polyps lacking respiratory epithelium. Similar grading was done to compare the depths of the basement membranes seen. Results are presented in table 6.

Metaplasia and Various Other Histologic Characteristics: Areas of metaplasia were evident in sections of antrochoanal polyps from 20 patients. In 19 these were areas of stratified squamous epithelium, and in the other one, areas of stratified squamous epithelium with other areas of a simple cuboidal type. Metaplastic areas were seen in sections of nasal polyps from 24 patients. Twenty-one of these were of the stratified squamous type; two of a low pseudostratified columnar, and one had areas of each of these two types.

A similar comparison was made of the degree of fibrosis seen in the sections; the degree of intercellular spaces or fluids (those two are often, though not necessarily, inversely related); the cellular constituents, including segmented granulocytes, round cells (lymphocytes, plasmacytes [plasma cells] and so-called endothelial leukocytes) and

erythrocytes; the vascularity; the degree of vascular sclerosis; the degree of perivascular infiltration with gradation of the numbers of segmented granulocytes and round cells, and glandular constituents (table 7).

Eosinophilia: The degree of tissue eosinophilia was graded more precisely by counting the average number seen in a section per microscopic field as viewed through a high power dry objective (table 8). Eosinophilia was considered present when the arbitrary figure of four or more eosinophils were found per field as viewed through a high

TABLE 7.—*Comparison of Histologic Characteristics of Antrochoanal and Nasal Polyps*

	Grade of Characteristic in Antrochoanal Polyps					Grade of Characteristic in Nasal Polyps				
	0-1	1	2	3	4	0-1	1	2	3	4
Fibrosis	1	10	30	11	2	2	25	21	5	1
Intercellular space or fluid	4	12	31	7	0	..	8	41	4	1
Cellular constituents										
Leukocytes	2	24	18	6	4	13	27	11	3	..
Round cells	1	16	24	12	1	..	5	29	10	..
Erythrocytes	11	18	20	2	3	18	19	12	5	..
Vascularity	6	27	14	4	3	7	14	19	14	..
Vascular sclerosis	26	5	10	2	1	38	9	5	2	..
Perivascular infiltration	42	8	2	1	1	39	11	4	..	..
Leukocytes	31	1	..	..	..	47	6	1	..	..
Round cells	42	8	3	..	1	38	12	3	1	..
Mucous glands*	..	..	1	..	1	3	11	9	8	3

* Mucous glands were completely absent in 52 cases of antrochoanal polyps and in 20 cases of nasal polyps.

TABLE 8.—*Tissue Eosinophilia of Antrochoanal and Nasal Polyps*

Eosinophils per Field*	Antrochoanal Polyps	Nasal Polyps
0-3	43	27
4-100	11	22
150-300	0	3

* As viewed through a high power dry objective.

power dry objective. Of the 43 patients whose antrochoanal polyps showed less than four eosinophils per field, only two had an average of one eosinophil per field, while in the tissue from the other 41, eosinophils were only occasionally, rarely or practically never seen.

Summary of Pathologic Appearance.—Thus, the dissimilarities between antrochoanal and nasal polyps, grossly and microscopically, are few. The small aperture through which the antrochoanal polyp must pass in many instances, however, gives it a characteristic dumbbell shape. On microscopic examination the nasal polyp frequently is seen to contain mucous glands, whereas the antrochoanal polyp rarely does. The nasal polyp also more frequently contains eosinophils, and to a much greater degree than does the antrochoanal polyp.

SUMMARY AND CONCLUSIONS

Because of a clinical impression of a difference in behavior of antrochoanal (Killian) polyps from that of ordinary nasal polyps, records of a series of 64 patients who had antrochoanal polyps have been reviewed; a comparison has been made between the surgical specimens from 54 patients with antrochoanal polyps with the specimens from 54 patients with ordinary nasal polyps, and the pertinent literature cited.

An incidence of 64 cases of antrochoanal polyps was found in a ten year period (1938 through 1947) at the Mayo Clinic. This incidence represents 3.7 per cent of 1,720 patients with nasal polyps, used as an inclusive term, seen in that ten year period.

Contrary to the generally accepted opinion, the antrochoanal polyps did not occur predominantly in children but affected the various age groups rather uniformly. The sex incidence was roughly two males to one female. The site of the antrochoanal polyp was approximately as frequent on the right side as on the left side. No definitely bilateral antrochoanal polyps were found.

Analysis of the records revealed that 15 (23.4 per cent) of these 64 patients with antrochoanal polyp had one or more positive criteria of an allergic manifestation. This incidence can be compared with the practically 100 per cent incidence of allergy yielded by the same criteria in cases in which the ordinary nasal polyp was present.

Microscopic examination of the tissues available from 54 of these patients revealed tissue eosinophilia in 11 (20.4 per cent). Eosinophilia was discovered nearly three times as frequently in the ordinary nasal polyp.

The roentgenologic examination of the sinuses was of definite diagnostic aid and is probably especially valuable when the history and physical findings are correlated by the surgeon.

It would appear that the external antrum operation best facilitates thorough and permanent removal of the antrochoanal polyp.

A comparison of antrochoanal and nasal polyps grossly and microscopically elicited only three dissimilarities. The frequently seen dumbbell shape of the intact antrochoanal polyp is characteristic. Nasal polyps frequently contain mucous glands; antrochoanal polyps almost never contain mucous glands. In nasal polyps tissue eosinophilia occurs more frequently and is of greater degree than in the antrochoanal variety.

These observations suggest that while the ordinary nasal polyp is of allergic origin the stimulus for the growth of the antrochoanal polyp is of a different nature. No light has been thrown by this study on the exact cause of the antrochoanal polyp.

N-BUTANOL: ITS USE IN CONTROL OF POSTOPERATIVE PAIN IN OTORHINOLARYNGOLOGICAL SURGERY

BERNARD WELT, M.D.
BROOKLYN

PAIN has always constituted a major problem confronting the medical profession, and methods for its satisfactory control have been explored by innumerable research and clinical investigators. The otorhinolaryngological surgeon is constantly aware of this problem in patients with various diseases in the head, neck and chest, as well as in patients after many different operative procedures. He is therefore interested in any field of research from which he can obtain assistance in his efforts to alleviate pain.

The purpose of this investigation was to determine the clinical significance of a new concept regarding the pathogenesis of pain in operative wounds and to determine the relief from pain obtainable through the therapeutic application of certain aspects of this concept. For this purpose, a study was made of the relief from pain obtained in several large groups of patients from the surgical wards of the ear, nose and throat service and the eye service of the Brooklyn Eye and Ear Hospital with the use of n-butyl alcohol.

PHYSIOPATHOLOGICAL ASPECTS OF PAIN

This study was based on the concept of pain production proposed by Revici [1] and his co-workers.[2] In order to provide a basis for the evaluation of the significance of the results obtained, I present the following brief summary of the observations of Revici and his associates.

There is an essential difference between pain caused by direct application of external noxious stimuli to normal tissues and pain due to tissue

---

The investigations presented in this paper were performed in the Ear, Nose and Throat Service of Dr. Frank L. Tucker, Brooklyn Eye and Ear Hospital.

1. (*a*) Revici, E.: The Pathogenesis of the Painful Focus, Pasteur **1**:33, 1942; (*b*) Considerations Concerning the Biology of the Painful Focus, Rev. de l'Inst. Franç. de l'Amerique latine **1**:114, 1945. (*c*) Revici, E.; Stoopen, E.; Frenk, E., and Ravich, R. A.: The Relation of Pain to Local Physico-Chemical Changes, Bull. Inst. Appl. Biol. **1**:21, 1949.

2. Stoopen, E.: Considerations About the Pathogenesis of Painful Foci, Pasteur **2**:73, 1944. Turner, S.: Contributions Concerning the Biology of Painful Foci, Policlinico (sez. prat.) **53**:1168, 1946.

damage or disease. The first type of pain is physiological; the second, pathological.[3] In surgery, the physiological pain caused by the actual operative procedure is controlled or averted by local or general anesthesia or by adequate amounts of narcotics. The pain that occurs at the site of the operative wound after the patient has recovered from anesthesia represents a form of pathological pain due to tissue damage. Relief from pathological pain is ordinarily sought by the use of local anesthetics or by the use of narcotics or analgesics which act on the cerebral cortex by elevating the pain threshold. It must be admitted that despite the many agents in use, postoperative pain still presents a definite problem to the surgeon. Pain and discomfort after tonsillectomy are frequently encountered during the first four postoperative days in children and for as long as 10 to 14 days in adults.

Pathological pain results in part from local physicochemical changes within diseased or damaged tissues. Revici placed particular emphasis on local changes in the p_H of the intercellular fluid bathing nerve endings within abnormal foci. Changes in the intensity of pain in such abnormal foci are directly related to the degree of deviation of the p_H of the tissue fluid in these areas from the normal range.[1e]

Changes in the acid-base balance of the whole body also influence pain intensity by affecting local p_H changes within abnormal foci. It was found that the general acid-base balance changes were reflected with a sufficient degree of accuracy by the p_H of the urine.[4]

In comparing the relation between pain intensity changes and alterations in the acid-base balance, two different types of pain patterns were observed. In one type, comparison of curves representing hourly changes in pain intensity and in the p_H of the urine shows a distinct parallelism. In this type, the pain is most intense when the body is relatively more alkaline and less severe when the body is relatively less alkaline (chart 1). In the second type, the pain is most pronounced when the body is relatively less alkaline and is least evident when it is more alkaline (chart 2). The first type of pain has been termed "alkaline pain"; the second, "acid pain."

Local alkalosis and local acidosis within abnormal foci are the result of the disturbed metabolism of diseased or damaged cells. Two different types of metabolic disturbance may be present, one leading to the accumulation of alkaline sodium compounds and an abnormally high p_H and the other to the accumulation of organic acids (especially lactic acid) and an abnormally low p_H.

In studying the physicochemical changes in tumors as well as in other abnormal tissues, Revici found that the cellular lipids have an important

3. Revici, E., and Ravich, R. A.: The Painful Focus: I. Physiological and Pathological Pain, Bull. Inst. Appl. Biol. **1**:12, 1949.

4. Revici, E.; Huesca-Mejia, C., and Ravich, R. A.: Correlation Between p_H of Urine and Blood Titrimetric Alkalinity, Bull. Inst. Appl. Biol. **1**:39, 1949.

and probably a major role in determining the type of metabolic change and the direction of the p_H disturbance within the intercellular fluids of the abnormal focus. The lipids therefore are an important factor in pain production.

An essential aspect of Revici's work has been a careful and precise systematization of lipids. He used the term "liposides" to include all chemical compounds of essentially similar composition. All substances composed of polar groups bound to predominant nonpolar groups are

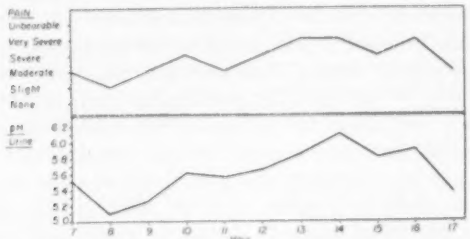


Chart 1.—Diagram of alkaline pain in a case of arthritis of the knee, showing parallel variations in pain intensity and urine p_H. From Revici and associates.[1c]

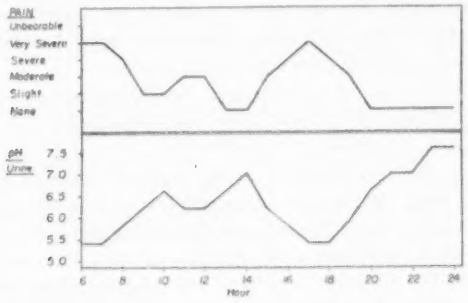


Chart 2.—Diagram of acid pain in a case of carcinoma of the prostate gland with painful metastatic focus in the left innominate bone, showing divergent curves of pain intensity and urine p_H. From Revici and associates.[1c]

defined as liposides. The term lipid has been retained to cover all such polar-nonpolar compounds found in nature, although Revici pointed out that such a distinction is of little real importance. The relation between the electrical forces that determine the predominance of the nonpolar groups has been studied by Mariani.[5]

5. Mariani, J.: The Liposides: II. A Study of Their Physico-Mathematical Properties, Bull. Inst. Appl. Biol. **1**:62, 1949.

For purposes of the present discussion, emphasis is placed on liposides having polar groups with acid functions, termed "lipoacids," and on those with basic or alcoholic functions, termed "lipobases." Lipoacids and lipobases are mutually antagonistic, both in vitro and in vivo.[6]

A predominance of lipobases in abnormal cells is associated with a disturbed metabolism leading to the accumulation of organic acids, which may produce acid pain. On the other hand, a predominance of lipoacids involves an altered metabolism leading to the accumulation of alkaline sodium compounds, which may cause alkaline pain.

Revici thus presented a new concept of pain production, emphasizing the physicochemical changes associated with abnormal foci and the important role of the lipids in determining the type of disturbed metabolism in such areas. On the basis of this concept, he endeavored to control pathological pain by using chemical substances that can influence the p_H of the intercellular fluids in abnormal tissue foci. Strong acidifying or alkalinizing agents, such as phosphoric acid or sodium bicarbonate, may influence pain by altering the general acid-base balance of the body. Such an approach to therapy has, however, been found to provide only very transitory results. The use of liposides has been found to be far more effective and capable of providing relief from pain over a much longer period. The liposides act locally on the disturbed metabolism of the abnormal tissue cells rather than on the pain threshold through an effect on the cerebral cortex or sensory nerves.

Stated simply, Revici used lipobases for the control of alkaline pain associated with lipoacid predominance and lipoacids for control of acid pain associated with lipobase predominance.

Although the determination of the type of pain pattern may be complex in many circumstances, the problem is relatively simple after surgical procedure, since Revici found that during the first postoperative period, which is ordinarily about four to six days, the pain is always alkaline and the lipoacids invariably predominate within traumatized tissues. Consequently, substances having the characteristics of lipobases should be used. When the healing processes are well established after the first few days, lipobases become predominant and the problem of pain relief usually disappears. In order to control the postoperative pain, Revici chose n-butyl alcohol as the lipobase.

In an attempt to judge the clinical value of this concept and the methods of pain control indicated by it, I studied the effects of n-butyl alcohol in a large number of postoperative cases.

6. Revici, E.: The Liposides: I. A New Systematization of Polar-Nonpolar Substances, Bull. Inst. Appl. Biol. **1**:49, 1949.

PHARMACOLOGY OF N-BUTYL ALCOHOL

n-Butyl alcohol is the four carbon, aliphatic, monohydroxy alcohol with the structural formula $CH_3CH_2CH_2CH_2OH$.[7] The molecular weight is 74.12; the boiling point is 116 to 118 C., and the substance is inflammable. It is completely soluble in neutral solvents and is 7.9 per cent soluble in aqueous solution at 20 C.

Experimental data on animals and man have revealed that n-butyl alcohol in aqueous solution has an extremely low toxicity. Fifteen hundred cubic centimeters have been administered daily for 10 days to patients by mouth, without any immediate or delayed undesirable side effects.[8] Intravenous administration of 500 cc. of a 7 per cent solution of n-butyl alcohol in saline solution has been found to cause no ill effects. In a few cases in the present series, n-butyl alcohol was administered in quantities totaling 250 to 300 cc. daily in divided doses, without any undesirable effects.

TABLE 1.—*Antibacterial Properties of the Butyl Alcohol Solutions*

Organisms	Per Cent n-Butyl Alcohol in Isotonic Saline Solution				
	7.5	3.7	1.9	0.9	0.4
Staphylococcus aureus	No growth	No growth	Growth	Growth	Growth
Hemolytic streptococcus	No growth	No growth	Growth	Growth	Growth
Escherichia coli	No growth	No growth	Growth	Growth	Growth
Bacillus subtilis	No growth	No growth	Growth	Growth	Growth
Clostridium tetani	No growth	No growth	Growth	Growth	Growth

In the following clinical investigations, n-butyl alcohol was administered intramuscularly in a 7.9 per cent isotonic saline solution. This solution is self sterilizing. In spite of this fact, the ampules or containers were sterilized at 100 C. for 30 minutes. Razor blades contaminated with representative pathological organisms were rendered totally sterile after immersion in this solution for one minute. The same bactericidal effect was observed in 3.7 per cent solutions. After further dilution, growth of organisms occurred (table 1).

METHOD OF ADMINISTRATION

n-Butyl alcohol was administered in a 7.9 per cent saline solution. The dose was 5 to 10 cc. for adults and 0.5 cc. per year of age for children under 12. The investigation was carried out in four separate steps. The

7. The chemical referred to in this paper is 1-butanol, which is the name approved by the International Union of Chemistry. The following synonyms are occasionally used and accepted: n-butanol, n-butyl alcohol, primary butanol and primary butyl alcohol.

8. Ravich, R. A., and Revici, E.: Toxicity of n-Butyl Alcohol, to be published.

first group of patients was chosen at random from among patients in the head, neck and chest services with postoperative pain. These patients received a single dose of n-butyl alcohol in order to observe whether any relief from pain occurred.

The second group of patients consisted of children under 12 years of age who had had a single type of operative procedure, tonsillectomy and adenoidectomy. These patients received a single dose of n-butyl alcohol. As a control on the effect on pain in this group, an exactly similar group received injections of isotonic saline solution instead of the n-butyl alcohol.

A third group, children with similar operative trauma due to removal of tonsils and adenoids, received three doses of n-butyl alcohol the first hour immediately before operation and three and seven hours after operation. Observations were made 12 hours later to determine whether any cumulative effect resulted.

In the fourth group, n-butyl alcohol was administered routinely to adults for pain after a variety of otorhinolaryngological and ophthalmologic surgical procedures. By this time, the nurses had been trained in its indication and use, and the observations of the nurses as to the effects of the substance on postoperative pain were recorded in a special book at 15, 30, 60, 120, 180 and 240 minutes after each injection.

In the evaluation of pain occurring after tonsillectomy, the following criteria were used. The patient was asked whether he had pain or not and checked several times at intervals of 10 minutes. To control a negative statement, the patient was asked to take a drink of water, and the definite refusal to drink or a grimace in the attempt to drink was considered a pain response. A case was considered nonpainful only when the subject was able to give an unequivocal response or was able to drink without grimace. In order to establish a control against which the effect of the administration of n-butyl alcohol could be evaluated, a number of untreated patients was employed.

In order to decrease the possibility of error in the personal element inherent in the observer, in some groups of patients the observation was made independently by two observers. To eliminate the personal factor in the observation, a group formed of treated and untreated patients was evaluated as to the presence of pain, without knowledge on the part of the observer as to the distribution of the patients treated with n-butyl alcohol. In addition, in one group observations were made on the wound appearance and the following pathological entities were studied: edema of the uvula, palate and pillars, ecchymosis, clots in the fossae and exudate in the fossae and on the pillars.

RESULTS

Group 1.—This preliminary group was composed of 74 patients from the head, neck and chest services who were complaining of pain at the wound site following various operative procedures (table 2). Restlessness and insomnia were controlled when necessary, on rare occasions, by barbiturates, but morphine and codeine were not administered. In all cases, single doses of n-butyl alcohol relieved pain for several hours.

TABLE 2.—*Operative Procedures in Preliminary Group of Seventy-Four Adults*

Operation	Number
Dacryocystorhinostomy	17
Tonsillectomy	13
Procedure for cleft palate	7
Nasal plastics	5
Esophagoscopy	5
Bronchoscopy	4
Submucous resection	3
Laryngectomy	3
Thoracotomy	3
Tracheotomy	2
Fenestration	3
Miscellaneous	10
Total	74

TABLE 3.—*Effect of Treatment on Pain Following Tonsillectomy and Adenoidectomy in Sixty-Five Children Under 12 Years of Age*

Treatment	Number	Per Cent
With n-butyl alcohol	40	..
Pain relieved for 4 hours or more	36	90
No relief	4	10
With isotonic saline solution	25	..
Pain relieved for 4 hours or more	4	16
No relief	21	84

Group 2.—This group comprised 107 children under 12 years of age whose tonsils and adenoids were removed. Sixty-five (61 per cent) of these complained of pain and 42 (39 per cent) did not complain of pain. The cases were studied in consecutive series over a period of several weeks, the children being under observation for six to nine hours after operation. Of the 65 children with complaints of postoperative pain, 33 were females and 32 males. n-Butyl alcohol was administered intramuscularly to 22 girls and 18 boys. Two girls and two boys continued to complain of pain following injection. However, 91 per cent of the girls and 89 per cent of the boys had relief from pain lasting three or more hours following the administration of a single dose of n-butyl alcohol.

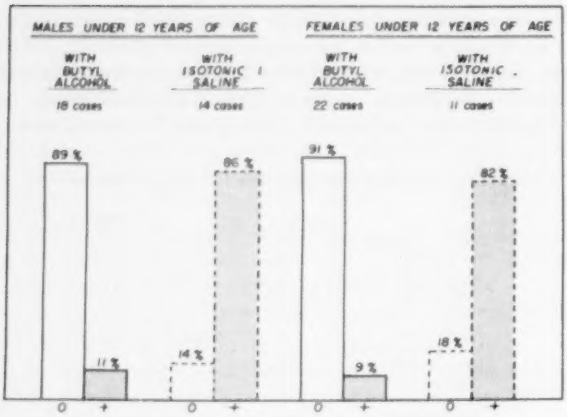


Chart 3.—Comparative effect of n-butyl alcohol and isotonic saline solution in male and female children under 12 years of age. The observation period was from 6:00 to 10:00 p. m. The columns marked with a circle indicate relief from pain for four hours or more; the columns marked with a cross indicate pain.

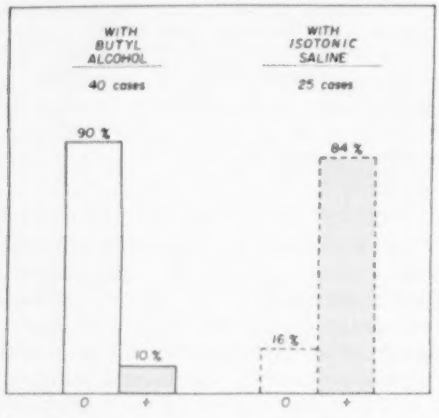


Chart 4.—The effect on pain in patients treated with n-butyl alcohol as compared with the effect in those treated with isotonic saline solution. The columns marked with a circle indicate little or no pain; those with a cross indicate pain.

Twenty-five subjects in this group served as controls and received injections of isotonic saline solution instead of n-butyl alcohol. Of 11 girls in this group, 9 continued to complain of pain, while only 2 stated that their pain had been relieved. In the 14 male controls, 12 continued to complain of pain and two reported relief from pain following the administration of the saline solution. Thus, of the saline-treated controls, relief from pain after injection was observed in 18 per cent of the females and 14 per cent of the males, as against 91 per cent in girls and 89 per cent in boys in the patients treated with a single dose of n-butyl alcohol (table 3; charts 3 and 4).

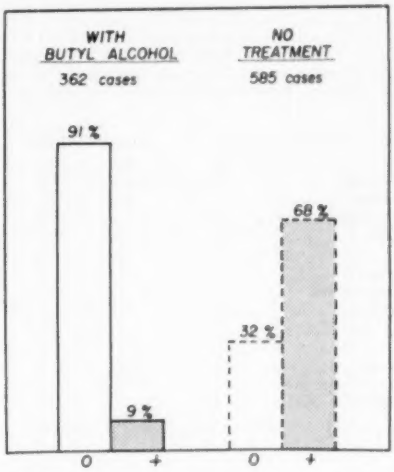


Chart 5.—Relief from pain 12 hours after the last injection of n-butyl alcohol. The columns marked with a circle indicate minimal or no pain; those with a cross indicate moderate or severe pain.

Group 3.—The possible cumulative effect of n-butyl alcohol on postoperative pain associated with removal of tonsils and adenoids in children was studied in a series of 362 patients. These patients received a preoperative dose of n-butyl alcohol at about 12:00 noon, were operated on about one hour later and then received two postoperative doses three and seven hours later. Immediate relief from pain between the hours of 4:00 to 9:00 p. m., following complete recovery from anesthesia, was observed in about 80 to 90 per cent of the cases, as in group 2.

Observations were made 12 hours after the last injection and revealed that 91 per cent of the patients treated with n-butyl alcohol had minimal

or no pain at that time; 585 untreated patients were examined as controls at the same time, and it was found that 32 per cent had little or no

TABLE 4.—*Relief from Pain Following Tonsillectomy and Adenoidectomy in Children Twelve Hours After Last of Three Injections of n-Butyl Alcohol*

Results	Number	Per Cent
With n-Butyl Alcohol	362	..
Minimal or no pain	329	91
Moderate or severe pain	33	9
With No Treatment	585	..
Minimal or no pain	187	32
Moderate or severe pain	398	68

TABLE 5.—*Results of Injection of n-Butyl Alcohol in Three Hundred and Ninety-Five Cases from the Ear, Nose and Throat Service*

Operation or Surgical Condition	Number	Total Pain Relief	Partial Pain Relief	No Relief
Tonsillectomy	254	248	5	1
Dacryocystorhinostomy	42	40	2	0
Submucous resection	36	31	5	0
Endaural radical mastoidectomy	24	12	1	0
Ethmoidal polyps	17	17	0	0
Nasal plastics	10	9	1	0
Acute pansinusitis	2	2	0	0
Radical frontal operation	2	2	0	0
Incision and drainage	2	2	0	0
Cauterization of nose	2	2	0	0
Paracentesis	1	0	1	0
Radical antrectomy	3	3	0	0
Removal of cyst on lower jaw	1	1	0	0
Removal of plastic skin graft	1	1	0	0
Thyroid cyst	1	1	0	0
Preauricular cyst	1	1	0	0
Fenestration	1	1	0	0
Esophagoscopy	5	5	0	0
Laryngeal polyp	1	1	0	0
Salivary calculus	2	2	0	0
Bilateral ethmoidectomy	1	1	0	0
Total	395	379	15	1
Per Cent	...	96.8	3.7	0.2

pain and 68 per cent had pain. It thus appeared that 9 per cent of the children had pain 12 hours after the last dose of n-butyl alcohol as compared, at the same time, with 68 per cent of the patients who had pain and did not receive the medication (table 4; fig. 5).

Group 4.—This group consisted of 395 patients from the ear, nose and throat service and 68 from the eye service. All had been subjected to the trauma of operation (tables 5 and 6); all were adults, and

all received n-butyl alcohol because they were complaining of pain. In a few instances, codeine and acetylsalicylic acid failed to relieve pain. The series covered ward cases between Nov. 30, 1948 and March 27, 1950. n-Butyl alcohol was given intramuscularly as often as every hour if necessary for the relief of postoperative pain. The name and age of the patient, the type of operation, the time of injection and the observations of pain at 15, 30, 60, 120, 180 and 240 minutes were all entered in a special logbook by the regular nurses on duty.

Of the 395 patients on the ear, nose and throat service, 379 (96.8 per cent) reported total relief from pain and 15 patients (3.7 per cent)

TABLE 6.—*Results of Treatment in Sixty-Seven Cases from the Eye Service*

Operation or Surgical Condition	Number	Total Pain Relief	Partial Pain Relief	No Relief
Senile cataract	26	22	3	1
Cyclodialysis	4	2	2	0
Detached retina	5	3	1	1
Iridectomy	3	3	0	0
Cyclodiathermy	4	4	0	0
Secondary glaucoma	2	2	0	0
Pterygium	6	6	0	0
Secondary membrane	4	4	0	0
Squint	3	3	0	0
Enucleation	1	0	0	1
Ziegler cautery	1	1	0	0
Excision of conjunctival cyst	1	1	0	0
Miscellaneous	8	6	2	0
Total	68	57	8	3
Per Cent	..	84	11	5

partial relief. In one case n-butyl alcohol failed to give some measure of pain relief.

Of the 68 patients in the ophthalmologic service, 57 (84 per cent) had total relief from pain; 8 (11 per cent) had partial relief, and 3 (5 per cent) had no relief. One patient on the eye service with bilateral glaucoma had no relief at all after several hourly injections. On investigation, it was found that, by error, this patient had been receiving isotonic saline solution instead of the n-butyl alcohol.

In this group of patients, pain was relieved in the majority of cases within five minutes after injection. The relief in most cases lasted for four or more hours. In three groups of untreated patients for whom three independent observers (two residents and I) were employed, the results concerning the presence of pain were almost identical (chart 6).

In 304 patients in group 3 treated with n-butyl alcohol, two different observers were used. Chart 7 shows the agreement of the results obtained

by these observers, each one in a certain number of cases. One of these observers made a simultaneous observation on treated and untreated

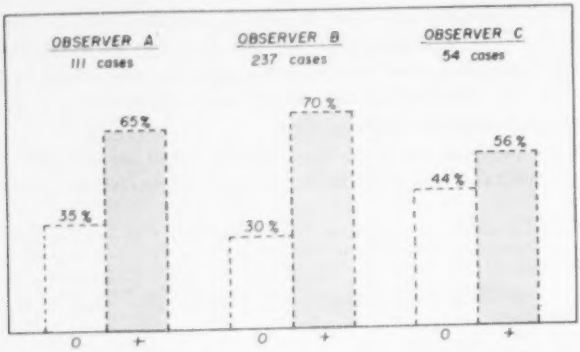


Chart 6.—Observations of three different observers in three different groups of subjects with no treatment. The columns marked with a circle indicate minimal or no pain; those with a cross indicate moderate or severe pain.

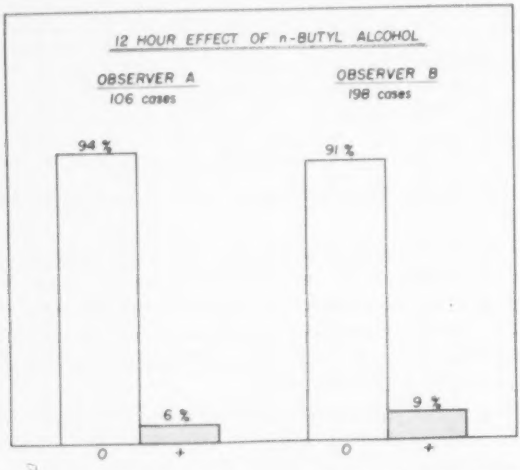


Chart 7.—Observations of two observers of the pain experienced in two different groups of patients 12 hours after administration of three injections of n-butyl alcohol. The columns marked with a circle indicate minimal or no pain; those with a cross indicate moderate or severe pain.

patients. These cases were broken down according to sex. Chart 8 shows the result of this observation. In the group of cases in which the observa-

tion was made by an observer without knowledge of the distribution of the n-butyl alcohol, the results still show a decided difference between treated and untreated patients (chart 9).

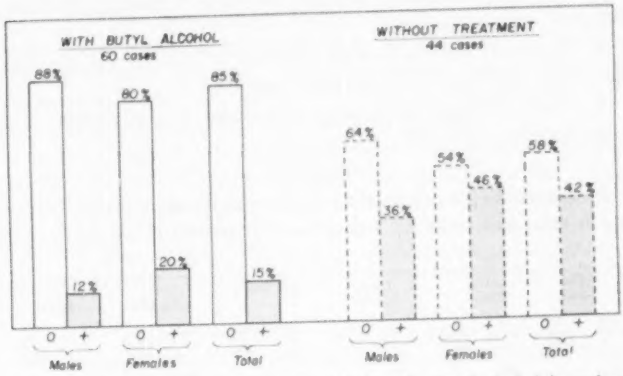


Chart 8.—Pain 12 hours after a last injection of n-butyl alcohol in male and female patients as compared with pain in an untreated group. The columns marked with a circle indicate minimal or no pain; those with a cross indicate moderate or severe pain.

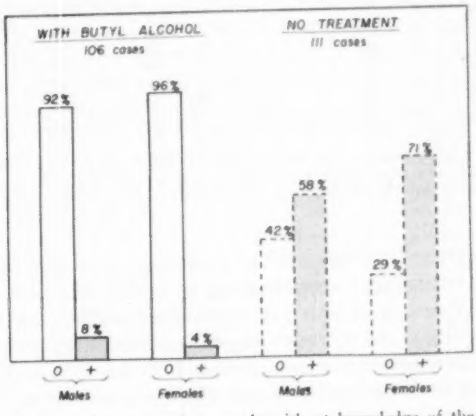


Chart 9.—Observations on patients made without knowledge of the distribution of the n-butyl alcohol 24 hours after the operation still show a decided difference between the two groups, the treated and the untreated.

In the group in which the pathological changes were checked the following observations were made:

1. Edema was less obvious in the treated than in the untreated patients. The most marked difference was noted in the region of the uvula.

2. The ecchymosis showed slight differences in favor of the treated patients.

3. There was little difference observed in the clots in the fossae between the treated and the untreated patients.

4. Some difference appeared in the exudate to a less extent in the treated patients (chart 10).

COMMENT

In investigating a new method for the alleviation of pain it is necessary to have some basis for comparison. It seemed to me that a single

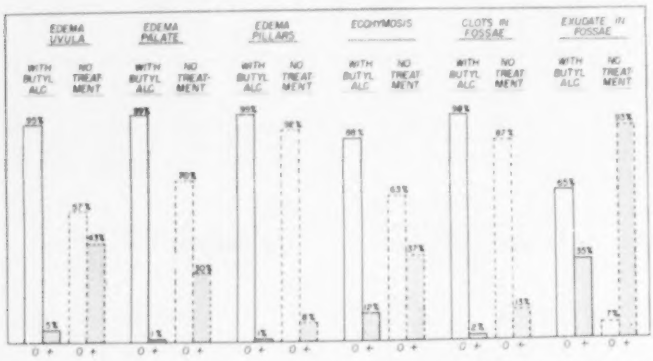


Chart 10.—Condition of the local lesions 20 hours after intervention, in cases with and without n-butyl alcohol treatment. There were 108 patients treated with n-butyl alcohol and 113 patients not treated. The columns marked with a circle indicate minimal pain; those with a cross indicate moderate or severe pain.

routine operative procedure such as a tonsillectomy and adenoidectomy provided a particularly favorable group of subjects for study. The fact that the pain associated with this procedure generally is not so intense, nor the locality of the operative wound so critical, makes it possible to utilize for comparative purposes controls receiving only placebos or no analgesics at all. In an active ear, nose and throat service, large numbers of patients are thus available who have a single standardized operative wound. Moreover, the reaction of children to pain can be less complex than that of adults, who may be either too stoical or too emotional regarding their discomfort. Even though the judgment of children may be less accurate in the interpretation of pain stimuli, their response is

sufficiently accurate for the observer to know whether they have pain or not. On the other hand, the adults, even though stoical or emotional, are better judges.

Instead of questioning the children in groups 2 and 3 as to the degree of pain, a simple test was used. Each child was given water to drink, and the degree of discomfort evident in the act of swallowing was taken as an expression of the pain. Children tend to exaggerate their pain, and, therefore, if there was little or no evidence of discomfort it was felt that a satisfactory measure of relief had been obtained.

The one remaining factor to be considered is the observer. In order to reduce the personal factor to a minimum, the observer had nothing to do with prescribing the type of after-care and was not informed as to what treatment had been given until after the degree of pain in each group of children had been recorded. In addition, independent observations were made not only by the author but by members of the house staff and nursing staff.

The treatment of postoperative wound pain with lipobase, n-butanol in this study, was based on previous studies regarding the physicopathology of wounds and wound pain by Revici and his co-workers. Unlike all other attempts to produce analgesia, this approach is directed not toward reducing the threshold of sensitivity of the nervous system but toward an alteration of the biochemical changes taking place at the level of the painful lesion itself. Revici pointed out that n-butanol, as well as all lipobases, is capable of relieving pain in certain circumstances but of increasing pain in other conditions. I have made the same observations in the administration of n-butanol to patients with pain due to various pathological conditions. Some patients may have acid and alkaline pain foci coexisting, and in such persons a lipobase may relieve the alkaline pain and, at the same time, increase the acid pain. Finally, there is no evidence that in the small doses used n-butanol has any effect on the central nervous system.

Revici stated that the pain present during the first few days after the production of a wound is always of an alkaline type and is associated with an excess of lipoacids and a local tissue alkalosis. It is therefore not necessary to make any elaborate studies as to the type of pain, and the same therapy may be used in all similar cases.

The results obtained in these four groups comprising 938 patients treated with n-butanol and 610 controls leave no doubt that n-butanol is an effective means of pain control (table 7). This favorable effect on postoperative wound pain confirms the clinical findings of Revici.

The short period of observation in the cases with a single operative procedure in the present study did not offer an opportunity to consider the aspect of wound healing. It may be stated, however, that the use of n-butanol in no way impaired wound healing, nor did it appear to

increase the tendency toward bleeding. It has been my experience that n-butanol in the dose range used is entirely lacking in undesirable side effects. Pain was relieved far more rapidly by n-butanol than with ordinary analgesics. In group 4 the nurses' recorded observations on 311 cases from the ear, nose and throat services and from the eye service indicated that relief was generally obtained within 15 minutes and, often, even within five minutes.

These observations appear to indicate that an important new avenue of approach has been opened by Revici's work in the study of abnormal foci. The results obtained in the clinical applications in control of post-operative wound pain suggest that the concept of the nature of pain, proposed by Revici, is of considerable practical significance.

TABLE 7.—*Composite Table of All Patients Treated*

Group	Character	Number Treated with n-Butyl Alcohol	Per Cent Pain Relief	Controls	Per Cent Pain Relief
1	Adult, preliminary	74	100	..	....
2	Children, tonsillectomy and adenoidectomy	40	50	25	16 *
3	Children, tonsillectomy and adenoidectomy	392	91 †	585	32 †
4	Adult, routine	402	92	..	....
	Total	908	...	610	....

* Treated with injections of saline solution.
† Nineteen hours after operation.

SUMMARY

n-Butanol was administered to a large number of patients with pain due to the trauma of various common otorhinolaryngological and ophthalmologic surgical procedures. Pain was relieved in approximately 90 per cent of the patients so treated.

These clinical results were considered in the light of studies by Revici and his co-workers regarding the physiopathology of wounds. The results indicate that the proposed concept of pain has significant practical clinical applications.

769 St. Marks Avenue.

Dr. Arnold de Veer, pathologist to the Brooklyn Eye and Ear Hospital, carried out the bacteriologic investigation. Dr. Frederick B. Traub, associate bacteriologist to the Jewish Hospital, Brooklyn, performed the bacteriologic studies on various dilutions of n-butyl alcohol. Miss Marta K. Olsson and Miss Eva Power assisted in the clinical investigations of the effects of n-butyl alcohol administered to the patients in their charge. Miss Mildred Cahill assisted in the investigation in group 3 of the effects of n-butyl alcohol as contrasted to the effects of isotonic saline solution.

MALAR BONE FRACTURES

M. M. HIPSKIND, M.D.
CHICAGO

THE OTOLARYNGOLOGIST by his training and his special knowledge of the malar-zygomatic region is keenly interested in the subject of trauma to this area. It seems paradoxical that the literature most frequently read by him should contain only rare reference pertaining to the diagnosis and the treatment of these injuries. During the war years the increased incidence of malar bone fractures stimulated new interest in the subject among otolaryngologists.[1] The Table of Organization of the Medical Department of the Army of the United States directed that an otolaryngologist be assigned to the maxillofacial team. Working in cooperation with other specialists he could obtain optimal results for the casualty. Débridement of the maxillary sinus, molding of its shattered wall and the reduction of the malar bone fracture were the problems of the otolaryngolosist. The pain of injury is the same in war or peace. With the exception of the higher incidence of penetrating wounds from high velocity missiles incurred in time of war, the problem of crushing injuries of the malar area encountered in civilian life ideally remains in the province of otolaryngology.

Analysis of the peculiarities of the injury to the malar-zygomatic region must be made in an orderly fashion if errors are to be avoided. Following is an outline of factors for consideration in analysis of the injury.

A. History
  1. How was the injury sustained
    (*a*) Automobile accident—blunt or sharp, hard or cushioned surface.
    (*b*) Altercation—blow of fist, knuckles, heavy instruments, e. g., lead pipe, gun butt
    (*c*) Sports—baseball,[2] collision with knee in football, boxing, etc.

Candidates' thesis presented in partial fulfilment of the requirements for membership in the Chicago Laryngological and Otological Society.

1. Alexander, J. E.: Early Treatment of Maxillofacial Battle Casualties: Résumé of 421 Cases. Arch. Otolaryng. **45**:637 (June) 1947.

2. An interesting fracture occurred in a 19 year old youth referred by Dr. Lloyd Holladay, Lafayette, Ind. A shattering injury was sustained by the malar bone with comminution of the maxillary sinus wall caused by a fouled ball in a collegiate baseball game.

(*d*) Penetrating wounds of high velocity missiles, knife wounds, etc.

2. Time of accident related to time of consultation
   (*a*) Early—without swelling
   (*b*) Moderately early—with swelling
   (*c*) Late—with flatness of cheek and fixation of fragments

B. Condition of patient
   1. General
      (*a*) Shock
      (*b*) Unconsciousness or consciousness
      (*c*) Injury to other parts
   2. Local
      (*a*) Estimate of damage to skin, (anesthesia of part supplied by the infraorbital nerve and numbness of the lower and upper lip; side of nose and maxillary teeth on affected side). Damage to muscle, mucous membrane, bone, facial nerve, parotid gland and duct
      (*b*) Dirt, oil or other foreign material in wound
      (*c*) Diplopia—arising from loss of support of eyeball; loss of vision from pressure on the nerve
      (*d*) Swelling—rich blood supply swells rapidly, heals quickly; hematoma, large vessels; emphysema, cracking of ethmoid sinuses
      (*e*) Flatness of traumatized cheek (after swelling subsides)
      (*f*) Pain on mastication resulting from attachment of masseter muscle to the fractured zygomatic arch
      (*g*) Cerebrospinal fluid from nose and anosmia (unequivocal signs of dural rupture)

C. Palpation
   1. Simple displacement—suture line separation
   2. Compound—frequently with sharp instruments and gunshot wounds
   3. Compound—comminuted, great force with fracture of the wall of maxillary sinus.
   4. Occlusion of teeth—malalinement

The face is the most conspicuous part of the anatomy. An unreduced fracture means a deformity. The surgeon treating facial injuries is confronted with a double problem. Not only is he required to restore function to the injured part, but he must also restore so far as possible a socially acceptable appearance to the face.

Ferris Smith stated that "the patient's future mental comfort and success in the competition of living will be materially influenced by his facial function and appearance." [3]

The malar eminence in its exposed position is particularly vulnerable to injury (fig. 1). It is covered by only a thin and highly vascular skin. It does not enjoy the cushion effect of other bones covered by thick and meaty muscles. Its rigid body is lateral to the compressible and elastic tissues of the infratemporal fossa and orbit. The large air-containing maxillary sinus is medial and below the thickest portion of the malar

3. Manual of Standard Practice of Plastic and Maxillofacial Surgery, National Research Council, Division of Medical Sciences, Philadelphia, W. B. Saunders Company, 1942.

bone. The four processes of the malar bone (frontosphenoidal, orbital, maxillary and temporal) are inflexible and separate under sudden sharp blows of force, driving the body of the bone against the lateral wall of the orbit and resulting in comminution of the bone. Thus pressure is made on important structures.[4] These possibilities must be recognized by the surgeon planning the correction of these fractures.

The zygomatic arch is palpated just beneath the skin (fig. 2). The broad radiating temporal muscle arising from the entire temporal fossa

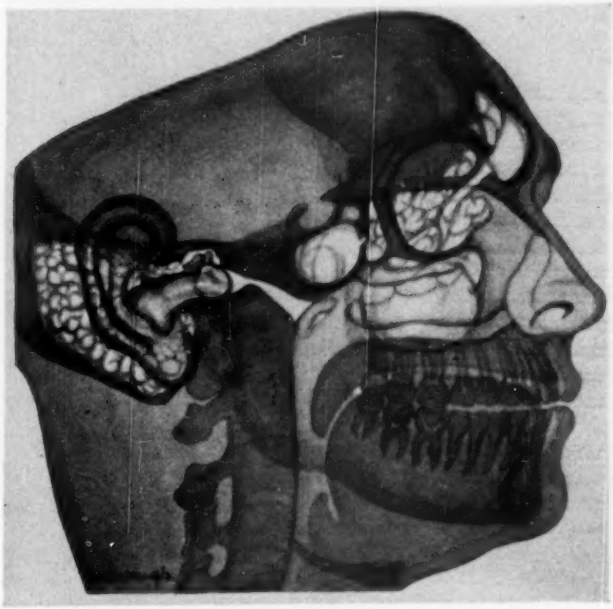


Fig. 1.—The pneumatic cavities of the head and their relation to the auditory system. Figure shows the external and internal channels of air to the two sides of the drum membrane.[19]

converges to end in a tendon which passes deep to the zygomatic arch and is inserted into the medial surface, apex and anterior border of the coronoid process and the anterior border of the ramus of the mandible as far forward as the last molar tooth. The fascia enveloping this muscle

4. A battle casualty seen by Dr. Frank W. Newell, then in charge of the Eye Department, 108th General Hospital, Paris, demonstrated a choked disk and blindness caused by pressure arising from comminution of the frontosphenoidal process on the lateral wall of the orbit, superior orbital fissure and optic foramen.

arises above from the superior temporal line but separates below into two layers, one which is inserted into the lateral and the other into the medial border of the arch.

Gillies[5] recommended the use of this anatomic separation of the temporal fascia as an avenue of approach to the fractured malar-

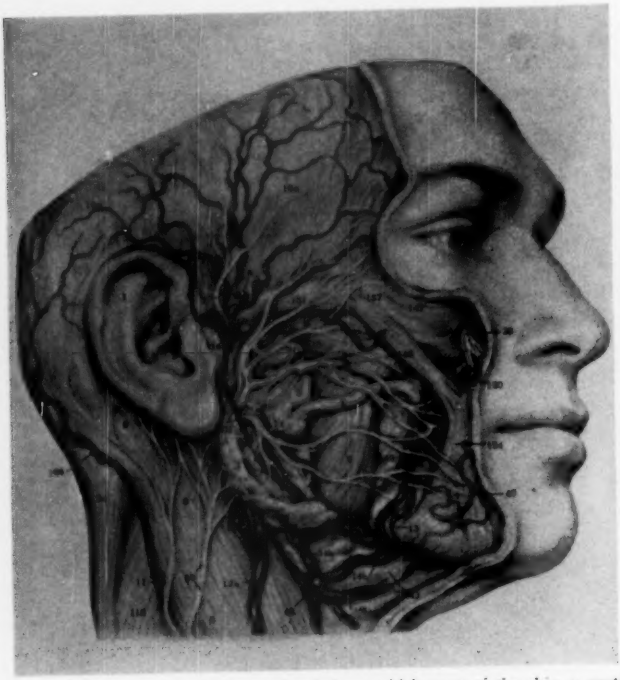


Fig. 2.—Right side of the human head, from which most of the skin, a portion of the parotid gland (*3*) with the superficial lymph glands and some of the superficial muscles (platysma, risorius) have been removed in order to show the underlying superficial structures of the face, the temporal region and the neck.[19]

1 indicates the auricle; *2*, external auditory meatus; *3*, parotid gland; *4*, parotid duct; *5*, masseter muscle; *6*, superficial temporal artery and vein; *7*, auriculotemporal nerve; *8*, sternocleidomastoid muscle; *9*, mastoid process; *10*, great auricular nerve; *11*, lesser occipital nerve; *12 a*, external jugular vein; *13*, facial artery; *14 a*, anterior facial vein; *14 b*, posterior facial vein; *15*, transverse facial artery; *16*, auricular cartilage; *19 a*, superficial temporal fascia; *36*, infraorbital foramen, nerve and artery; *40*, inferior labial artery; *43*, submandibular gland; *45*, common facial vein; *106*, occipital artery; *118*, splenius capitis muscle; *145*, posterior auricular vein; *146*, zygomatic muscle; *147*, orbicular muscle of the eye; *148*, submental vein; *149*, adipose facial pad; *150*, angular artery and vein; *151*, zygomatic arch; *154*, orbicular muscle of the mouth; *157*, zygomatic bone, or cheekbone, and *VIII*, facial nerve.[19]

5. Gillies, H. D.; Kilner, T. P., and Stone, D.: Fractures of the Malar-Zygomatic Compound, with Description of New X-Ray Position, Brit. J. Surg. **14**:651, 1927.

zygomatic compound. The temporal region is shaved and surgically prepared. An incision is made in the hair line just above and in front of the ear and is carried down to the temporal fascia, which is split in the direction of the fibers. A specially constructed long, thin elevator is passed beneath the superficial fascia. The instrument "tends to slip behind the fragment" between the separated sheaths of fascia attached

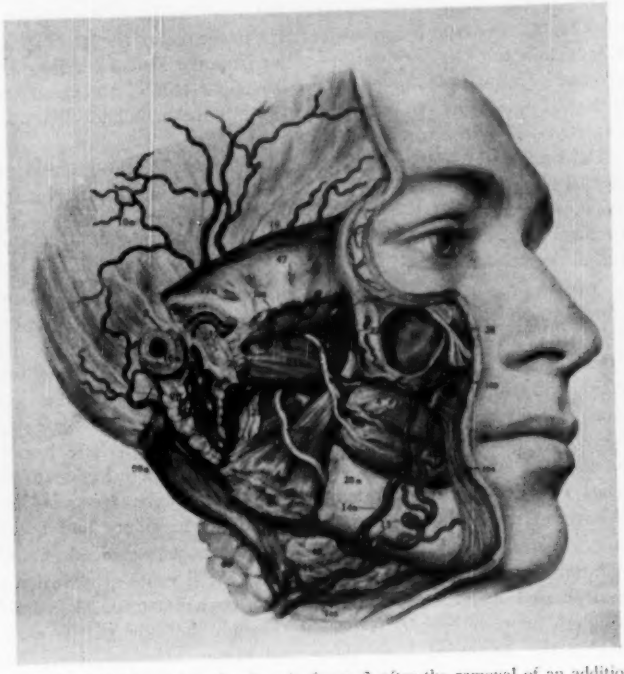


Fig. 3.—Side view of the head, as in figure 2, after the removal of an additional block represented in the right hand drawing in figure 4.

2 indicates the external auditory meatus; *3*, parotid gland; *4*, parotid duct; *6*, superficial temporal artery and vein; *7*, auriculotemporal nerve; *9*, mastoid process; *13*, facial artery; *14 a*, anterior facial vein; *14 b*, posterior facial vein; *16 a*, cartilage of external auditory meatus; *17*, mandibular joint (*17 a*, articular fossa and eminence; *17 b*, head of mandible; *17 c*, articular disk); *18*, maxillary air sinus; *19*, temporal muscle; *19 a*, superficial temporal fascia; *20*, inferior dental, or alveolar, artery; *21*, inferior dental nerve; *22*, posterior superior dental arteries; *23*, lateral pterygoid muscle (*23 a*, upper part of the head; *23 b*, lower part); *24*, medial pterygoid muscle; *25 a*, external carotid artery; *26*, maxillary artery; *27*, maxillary arterial branch for muscles of mastication; *28*, buccal nerve and artery; *34*, lingual nerve; *36*, infraorbital foramen, nerve and artery; *37*, maxilla, or upper jawbone; *38 a*, body of the mandible; *40*, inferior labial artery; *43*, submandibular gland; *45*, common facial vein; *46*, upper deep cervical lymph glands; *47*, temporal surface of skull; *48*, buccinator muscle; *57*, posterior auricular artery; *59 c*, posterior belly of digastric muscle; *63*, stylohyoid muscle; *148*, submental vein; *150*, angular artery and vein; *154*, orbicular muscle of the mouth; *155*, masseteric artery and nerve, and *VII*, facial nerve.[19]

to the medial and lateral borders of the arch. Between these two layers of fascia is a small quantity of fat, the orbital branch of the superficial temporal artery and a filament from the zygomatic branch of the maxillary nerve. These structures doubtlessly are in the path of the elevator when the temporal route for elevation of malar fractures is used.

The heavy and thick masseter muscle consists of two parts. The larger superficial portion arises from the zygomatic process of the maxilla and the anterior two thirds of the lower border of the zygomatic arch. Its fibers pass to the insertion in the lower half of the latter surface of the mandible. The deep portion arises from the medial surface of the zygomatic arch and is inserted into the upper half of the ramus and the lateral surface of the coronoid process of the mandible. Behind, it is surrounded by the parotid gland.

Unlike the masseter and the temporolis muscles, the internal and external pterygoid muscles do not, by their origin, insertion and action, directly affect the malar-zygomatic bone fracture. It is well, however, to remember that these remaining muscles of mastication occupy a large part of the infratemporal fossa (fig. 3).

A second method of elevation of the depressed malar fracture is use of the intraoral route.[6] The area of the gingivobuccal fold is prepared for incision by cleansing with soap and water, followed by the application of the usual surface antiseptics. The elevator is introduced through the incision and is directed upward and backward underneath the surface of the malar bone. The depressed fragment is pried upward and is guided by external manipulation into proper position. The technic has the advantage of leaving no surface scar. The danger of infection to the tissues crowded in the infratemporal fossa must be recognized by the surgeon using this method. Injury to the maxillary and middle meningeal arteries and the pterygoid muscles cannot be avoided (fig. 4).

Patterson[7] and Gill[8] suggested a direct facial route of elevation of the depressed malar bone and zygomatic arch fracture. A suitable tenaculum or towel clamp is passed through the skin of the cheek, grasping the depressed bone above and below. Traction is applied, pulling the fragmented bone and arch into proper position. Whereas this technic is applicable to the simple elevation of the arch, it is not without danger in those cases of extensive fracture of the deeper parts of the malar-zygomatic bone.

---

6. Goldthwaite, R. H.: Plastic Repair of Depressed Fracture of Lower Orbital Rim, J. A. M. A. **82**:628 (Feb. 23) 1924. Straith, C. L.: Management of Facial Injuries Caused by Motor Accidents, J. A. M. A. **108**:101 (Jan. 9) 1937.

7. Patterson, R. F.: Treatment of Depressed Fractures of Zygomatic (Malar) Bone and Zygomatic Arch, J. Bone & Joint Surg. **17**:1069, 1935.

8. Gill, W. D.: Fractures of the Facial Bones with Special Reference to Involvement of the Paranasal Sinuses and Orbits, South M. J. **27**:197, 1934.

New [9] makes a small nick in the skin for the purpose of introducing an especially designed hook. The hook is thin but strong. The elevator part of the hook is passed beneath the fragments. At the opposite end a ring in the same plane of the hook is used to inform the surgeon of

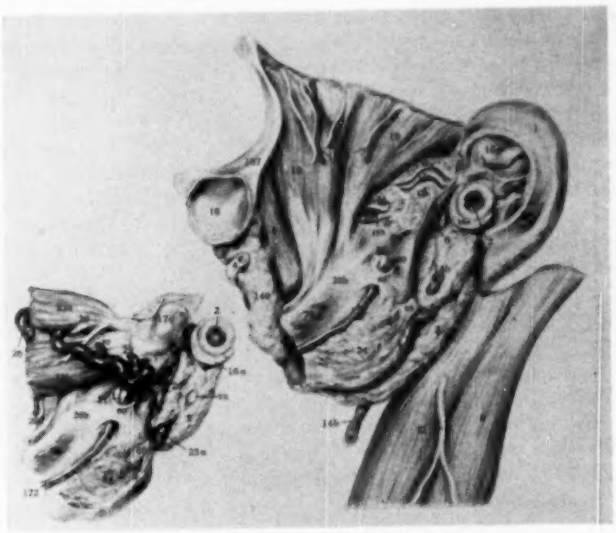


Fig. 4.—Inside view of the lower jawbone (*38*), mandibular joint (*17*) and the related structures of the face and neck shown in figures *2* and *3*. The plane of the right hand figure passes through the infraorbital foramen (*36*) anteriorly and just inward of the auricle (*1*) posteriorly. The mandibular joint (*17*) and the external auditory meatus (*2*) are seen in cross section. The zygomatic arch (*151*) and bone (*157*) have been removed, and the maxillary sinus (*18*) has been opened. The plane of the left hand figure is slightly inward from the preceding area, leaving the lower compartment of the joint covered with the cartilaginous articular disk (*17 c*) and the lateral pterygoid muscle (*23*), with its accompanying nerves and blood vessels, in place.

1 indicates the auricle; *2*, external auditory meatus; *3*, parotid gland; *4*, parotid duct; *5*, masseter muscle; *6*, superficial temporal artery and vein; *8*, sternocleidomastoid muscle; *14 b*, posterior facial vein; *16*, cartilage of auricle; *16 a*, cartilage of meatus; *17*, mandibular joint (*17 a*, articular fossa and eminence; *17 b*, head of mandible; *17c*, articular disk); *18*, maxillary air sinus; *19*, temporal muscle; *20*, inferior dental artery; *21*, inferior dental nerve; *23*, lateral pterygoid muscle (*23 a*, upper part of the head; *23 b*, lower part); *24*, attachment of medial pterygoid muscle; *25 a*, external cartoid artery; *26*, maxillary artery; *28*, buccal nerve and/or artery; *29*, middle meningeal artery; *30*, accessory meningeal artery; *38 b*, mandibular ramus; *60*, sphenomandibular ligament; *65*, stylomandibular ligament; *70*, superior constrictor muscle of pharynx; *149*, adipose facial pad; *155*, masseteric artery and nerve; *157*, zygomatic bone, or cheekbone; *159*, deep temporal arteries and nerves; *172*, mylohyoid artery and nerve; *VII*, facial nerve and *XI*, accessory nerve.[18]

9. New, G. B.: Fractures of the Nasal and Malar Bones, S. Clin. North America **15**:1241, 1935.

the position of the hook under the fragment. In cases of serious comminution the hook is left in place and traction is applied to give support until some fixation has resulted.

Kanzanjian [10] drills a small hole through the displaced bone. A no. 25 wire is passed through the hole and brought over the infraorbital rim out through the skin and is made into a hook by bending the two distal wires. A plaster cap is made, incorporating a no. 8 heavy wire in a position to supply upward and outward traction by attaching the two wires with elastic bands.

The nasal route described by Shea [11] and Watkins [12] and used in the European theater of operations by Hoople establishes proper drainage to the antrum and permits the removal of blood clots. It has the advantage of leaving no surface scar, and in skilled hands no important structure is damaged. An intranasal antrostomy is performed. A urethral sound is introduced through this window, and the depressed malar bone is levered into position. Care must be exercised to avoid injury to the orbital tissues. The distal curved and rounded part of the sound must be directed only against the medial surface (antrum wall) of the malar bone. Not infrequently, the floor of the orbit is comminuted in malar fractures. In these cases the sound readily passes into the orbit, provoking additional damage.

The antrum route has been most popular with otolaryngologists. The method has been in vogue many years and is the technic recommended by Blair,[13] Lathrop [14] and Naftzger.[15]

An incision is made in the gingivobuccal sulcus and extended forward across the gingivolabial fold. The mucous membrane and periostium are carefully elevated over the canine fossa. The incision is extended anteriorly to the piriform crest and posteriorly to the maxillary tuberosity.

Fracture of the anterolateral wall of the sinus is commonly observed. If no comminution is present, an opening into the sinus is made by removing the anterolateral wall with mallet and gouge. If the anterolateral wall is fractured a cerumen hook is used to tease away broken

10. Kanzanjian, V. H.: Treatment of Injuries of Upper Part of Face, J. Am. Dent. A. **14**:1607, 1927.

11. Shea, J. P.: The Management of Fractures Involving the Paranasal Sinuses, J. A. M. A. **96**:418 (Feb. 7) 1931.

12. Watkins, A. B. K.: Treatment of Depressed Fractures of Malar Bone, Brit. M. J. **1**:327, 1937.

13. Blair, V. P.; Ivy, R. H., and Brown, J. B.: Essentials of Oral Surgery, ed. 2, St. Louis, C. V. Mosby Company, 1936.

14. Lathrop, H. A.: Fracture of the Superior Maxillary Bone Caused by Direct Blows over the Malar Bone, Boston M. & S. J. **154**:8, 1906.

15. Naftzger, J. B.: Fractures of the Facial Bones Involving Nasal Accessory Sinus, Am. Otol., Rhin. & Laryng. **37**:486, 1928.

fragments of the wall of the sinus. In this fashion a large portal is made for the surgical correction of the fracture.

The condition of the infraorbital canal and its nerve and blood vessels are noted. Clots of blood and other foreign materials are removed from

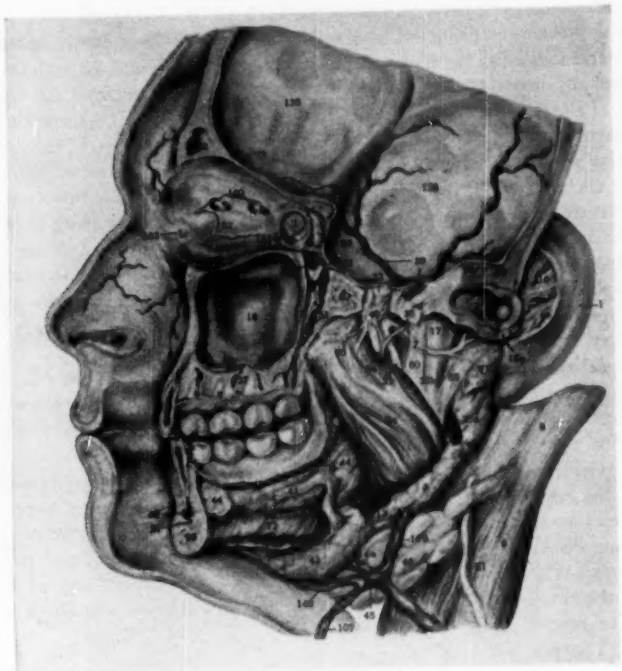


Fig. 5.—Back view of the slab depicted in the preceding figure, showing the cranial cavity (*135, 136*), orbital contents (*52*), maxillary sinus (*18*), mouth and other deep structures of the head.

1 indicates the auricle; *2*, the external auditory meatus; *3*, parotid gland; *7*, auriculotemporal nerve; *8*, sternocleidomastoid muscle; *13*, facial artery; *14 a*, anterior facial vein; *14 b*, posterior facial vein; *16* and *16 a*, cartilage of auricle and external meatus; *17*, mandibular joint; *18*, maxillary sinus; *20*, inferior dental artery; *21*, inferior dental, or alveolar, nerve; *24*, medial pterygoid muscle; *25 a*, external carotid artery; *29*, middle meningeal artery and its branches; *31*, maxillary nerve; *32*, mandibular nerve; *34*, lingual nerve; *35*, chorda tympani; *36*, infraorbital nerve and artery; *37*, maxilla, or upper jawbone; *38*, mandible, or lower jawbone; *38 b*, mandibular ramus; *41*, submandibular duct; *43*, submandibular gland; *44*, sublingual gland; *45*, common facial vein; *46*, upper deep cervical lymph glands; *49*, otic ganglion; *50*, nerve for tensor muscle of the soft palate; *51*, palatine nerves and descending palatine artery; *52*, orbital contents; *53*, ophthalmic nerve; *58*, temporal bone; *60*, sphenomandibular ligament; *65*, stylomandibular ligament; *72*, mylohyoid muscle; *78*, frontal sinus; *80*, sphenoidal bone; *107*, superior thyroid vein; *135*, anterior cranial fossa; *136*, middle cranial fossa; *148*, submental vein; *160*, anterior and posterior ethmoidal arteries and veins; *161*, ophthalmic artery; *163*, lacrimal canaliculi; *II*, optic nerve; *VII*, facial nerve and *XI*, accessory nerve.[19]

the antrum, and a direct inspection is made of the walls. In severe comminution, the wall of the maxillary sinus is shattered, in a fashion appropriately described by Lewis,[16] like the cracked shell of an egg."

The contour of the sinus is studied to determine the direction of the displacement of the malar bone. A force directed from in front of the malar bone will drive the body posteriorly, decreasing the horizontal anteroposterior diameter of the sinus. A blow directed against the lateral surface of the malar-zygomatic bone and arch will drive the bone medially, narrowing the horizontal lateral-medial diameter of the sinus.

Palpation of the sinus wall associated with external pressure on the malar bone will establish valuable information. As the body of the malar bone is pressed inward, the palpating finger in the sinus can be used to elicit the direction of major displacement of the bones involved in fracture. Indeed, without this digital manipulation from without inward, the surgeon is unable to unlock the underlying fragments. Carefully exaggerating the depressed traumatic defect of the injury by externally applied manual pressure will suggest the proper manipulation to bring the bone gently back into position. The use of heavy instruments for lever action is avoided.

The elevating force is directed by the finger within the sinus (fig. 5). No important structure is damaged by this technic. All vessels, nerves, muscles and glandular tissue of significance are outside the wall of the sinus.

Gentle rocking of the body of the malar bone produced by pressure of the fingers of the one hand against the cheek and the index finger of the other hand directed against the antrum surface will free the underlying displaced fragment from the immobile margins of the fixed structures. When proper elevation has been accomplished the internal wall of the antrum will feel smooth and the normal contour of the cheek will have been restored.

The position may be maintained by intrasinus packing. Brown[17] stated that "severe crumpling of the antral wall is handled by iodoform packing of the sinus." I use radiopaque gauze.[18] The creation of a window from the antrum into the inferior meatus of the nose has been discontinued. The packing can be removed from the sinus through the partially closed incision in the gingivobuccal region. In no case has a fistula followed this procedure.

Four days after all the packing has been removed, a roentgenogram of the antrum is taken. If no evidence of radiopaque packing is demonstrated on roentgenographic studies, and the position of the fragments

16. Lewis, G. K.: The Fractured Mandible, J. Oral Surg. **8**:95, 1950.

17. Brown, J. B.: Fractures of Bones of Face, Surg., Gynec. & Obst. **68**:564, 1939; Am. J. Orthodontics **25**:432, 1930.

18. Bauer and Black.

is found satisfactory, the incision is permitted to close. No infections of the maxillary sinus that could be attributed to this management have occurred. Painstaking débridement of the sinus and supportive chemotherapeutic agents are important factors in the successful outcome of these procedures.

In the absence of severe comminution of the maxillary sinus, wall packing is not required. If the fracture in the main involves the arch

Fig. 6.—Head bandage on patient, with simple elevation and traction.

and is associated with suture line separation at the frontosphenoidal and maxillary processes, simple elevation and traction will suffice (fig. 6).

Stereoscopic roentgenographic films are made in the anterior, lateral and axial planes. Careful study of these views will demonstrate the fracture and the position of the displaced fragments. The sinus walls are searched for evidence of fragmentation. If only suture line separation with depression of the arch is presented the following technic will be found adequate.

The area is cleansed with soap and water, alcohol and ether. A drop of local anesthestic is deposited in the skin. The needle is directed inward until it meets the lower margin of the zygomatic process of the malar bone, where another drop or two of the anesthetic agent is deposited. A small amount of local anesthesia is deposited in a "canal" as the syringe and needle are withdrawn from the tissues. A similar injection of the anesthetic material is deposited in a like fashion just

Fig. 7.—The eye of the hook is attached to rubber bands looped around the tongue blades.

above the upper margin of the zygomatic process. The two points of the injection are usually a centimeter apart.

A sterile 6/0 fish hook from which the barb has been removed is passed through the lower area of anesthesia, curving behind the zygomatic process or the arch as desired. The point of the hook may be directed into the posterior medial surface of the body of the malar bone and elevating traction applied. Gentle traction may be sustained in any

desired direction by attaching the eye of the hook to rubber bands looped around the tongue blades, as demonstrated in figure 7.[19]

The head piece is constructed by wrapping the head with elastic 3 inch (7.6 cm.) bandage in hatband fashion. Care to avoid a too tightly applied bandage will be appreciated by the patient. The bandage acts as a cushion for the spring of the tongue blades at the fulcrum and as an anchor for the upper end. It is advisable to wrap the bandage well below the level of the occipital protuberance if heavy elastic traction is indicated. If this procedure is neglected the pull of the elastics may "lift off" the head bandage.

The tongue blade apparatus is constructed of four sturdy and flexible wooden tongue blades. The two central tongue blades overlap the distal tongue blades in the region of the proximal halves. They are secured tightly together by ample adhesive tape wrapping.

The use of the method has the advantage of gentle and gradual reduction of the fracture. The fragments are maintained in correct position without intrasinus packing. Packing is objectionable to the patient not only because it must be removed but also because of the malodorous stimuli arising from packing in the maxillary antrum.

The splint meets the necessary qualifications, i. e., it is comfortable, simple and sturdy in construction. The elastic head bandage is easily applied and more comfortable than the hard plaster of paris head cap. The simplicity of the technic with the small amount of anesthesia required can be used to give traction in any desired direction.

Reduction in the number of elastic bands reduces the amount of pull as the need for traction force is reduced, as manifested by the return of the fragments to proper position. The splint permits the patients' early discharge from the hospital, a consideration of increasing importance today with the shortage of hospital beds and rising cost of hospital care. The patient should sleep with the head in a slightly elevated position to avoid displacement of the splint by contact with the head of the bed.

Malar bone fractures are not recognized early in patients incurring multiple injuries. The more serious and obvious fractures and wounds are treated in an effort to combat shock and save lives. During the war malar bone fractures were not infrequently seen by the otolaryngologist only after the swelling had subsided or after the major injuries incurred by the soldier no longer engaged his full attention.

---

19. Since illustrations reveal more than words, I included figures 1, 2, 3, 4 and 5 by Miss Gladys McHugh, medical illustrator of the University of Chicago Clinic, from the excellent book "The Human Ear," published under the auspices of the Sonotone Corporation.

The head band bandage, tongue blade and elastic rubber band traction was used originally by Stout to produce forward traction for the posterior displacement of superior maxilla fractures. Colonel Cashman suggested the hook idea to me during the Battle of the Bulge. The method described was used successfully at the bedside of casualties. In this manner, movement was avoided by the seriously ill and by the patients in cumbersome long bone traction appliances.

6060 Drexel Avenue.

NASAL CAVITY OF THE GUINEA PIG IN EXPERIMENTAL WORK

GEORGE KELEMEN, M.D.
BOSTON

THE USE of animals in biologic experiments should be based on (1) perfect orientation as to the normal anatomy and histology of the animal in question and (2) knowledge of pathologic conditions arising without experimental interference. Previous studies [1] concerning the rat have shown that, while anatomic relations are far from being sufficiently explored, the nonexperimental pathologic processes, though generally known, are widely disregarded. In the rat, these two circumstances combine well nigh to demolish the cornerstone of experimental work—the idea of the so-called control animal.

Available data on gross anatomy lag behind those regarding histology. Competent information about the elements of the mucous membranes, respiratory and olfactory, is available, but no survey has been made on detailed anatomy of the nasal cavity of animals in daily laboratory use. In older monographs little attention was paid to the needs of the laboratory worker; even so, data found in them are repeated and used without much needed reexamination. On the other hand, in recent monographs about these animals the nasal cavity is neglected.

Following a plan to investigate the common laboratory animals on the basis of the principles just mentioned, we chose the guinea pig as next in line. Though the nasal cavities of the rat and rabbit are used far more frequently in assays of nasal medicaments and other experiments, it seemed logical, after dealing with the rat and before going over to the rabbit, to examine the guinea pig, another rodent. Today, the rabbit is considered as belonging not to a suborder of the rodents but to the separate order, Lagomorpha.[2]

From the Biological Laboratories and the Department of Otolaryngology, Harvard University. This study was aided by a grant from the Ella Sachs Plotz Foundation.

1. Kelemen, G.: The Junction of the Nasal Cavity and the Pharyngeal Tube in the Rat, Arch. Otolaryng. **45**:159-168 (Feb.) 1947; (*b*) The Nasal Cavity of the Rat in Pharmacological and Other Experimentation, Science **107**:273-274 (March 12) 1948. (*c*) Kelemen, G., and Sargent, F.: Nonexperimental Pathologic Nasal Findings in Laboratory Rats, Arch. Otolaryng. **44**:24-42 (July) 1946.

2. Romer, A. S.: Vertebrate Paleontology, ed. 3, Chicago, University of Chicago Press, 1947.

A better knowledge of the anatomy of the guinea pig is warranted not only for the sake of physiologic and pharmacologic experimentation but because this animal plays its part in experimental psychology. In the prenatal guinea pig Carmichael [3] studied contraction and dilation of the nostrils, together with the olfaction. He found that the contraction and dilation of the nostril may be considered a local reflex, part of a more general pattern, important in regulating olfactory stimuli.

MATERIAL AND METHODS

To get a more comprehensive picture of the conditions to be considered, the animals studied were taken from the stocks of different laboratories. By their respective animal farms they were labeled as being in perfect health, and nobody would have raised objection to their use as "controls." Their ages averaged between 4 and 8 months, with an average weight between 300 and 450 Gm. After decapitation, the heads were preserved in a 4 per cent solution of formaldehyde. After fixation for at least four weeks they were decalcified in a 5 per cent solution of trichloroacetic acid before dissection under the binoculars of a wide field microscope. A block was prepared containing the entire nasal cavity. Twelve of these blocks were embedded in celloidin and cut in serial sections for microscopic examination. Nine of the blocks were cut in the frontal and three in the horizontal plane. Topography, and not finer microscopic details, was the scope of this study, and the sections were therefore prepared with an average thickness of 15 microns. Hematoxylin and eosin, Van Gieson's stain, Mallory's collagen stain and Gömöri's impregnation technic were used, and a part of the sections, unstained, were examined under polarized light.[4]

OBSERVATIONS

First, a short survey of the nasal passages is given with four plates (figs. 1, 2, 3 and 4), each showing a macroscopic photographic reproduction of a sagittal section with an attached explanatory drawing.

Figure 1 represents a paramedian section with the nasal septum in situ. The outstanding feature in this section is the "window" in the lowest part of the septum behind the bulge representing the blind end of the vomeronasal organ. Conditions around this window are similar to those found in the rat and described in detail in two previous publications.[1a, c] Compared with similar illustrations of the nasal cavity in the rat, the main difference in this picture is a generally higher and shorter nasal chamber.

3. Carmichael, L.: An Experimental Study in the Prenatal Guinea Pig of the Origin and Development of Reflexes and Patterns of Behavior in Relation to the Stimulation of Specific Receptor Areas During the Period of Active Fetal Life, Genet. Psychol. Monogr. **16**:337-491 (Nov.-Dec.) 1934.

4. The histologic work was done by Miss Dorothy Linden and the photomicrography by Mr. Richard W. St. Clair; the drawings were prepared by Mr. William O'Leary.

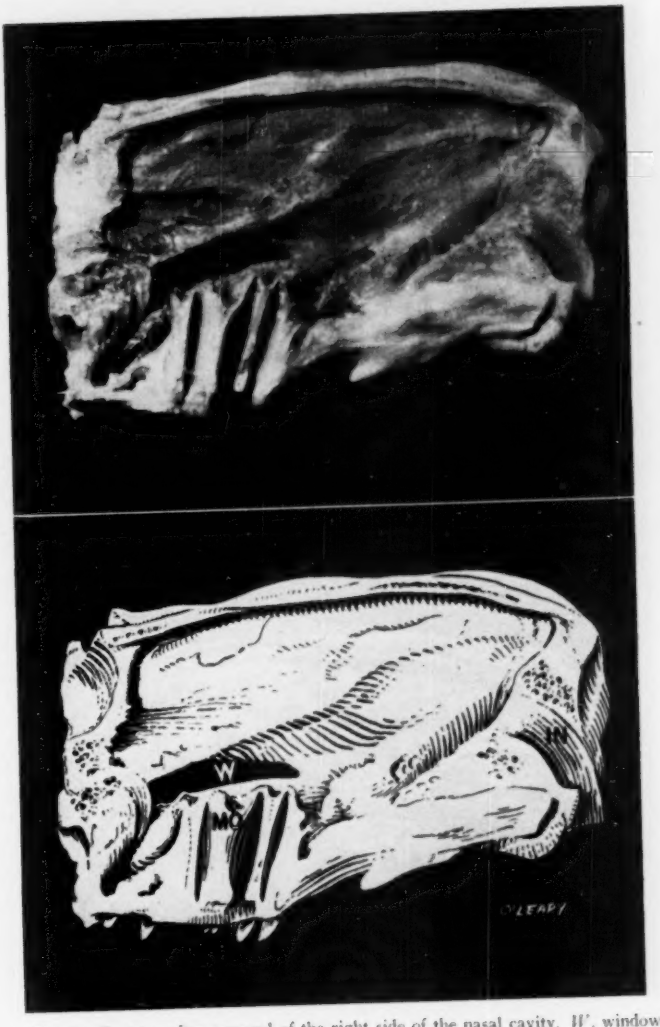


Fig. 1.—Septum, after removal of the right side of the nasal cavity. *W*, window in the choanal region posterior to the vomeronasal organ; *IN*, incisor; *MO*, molars.

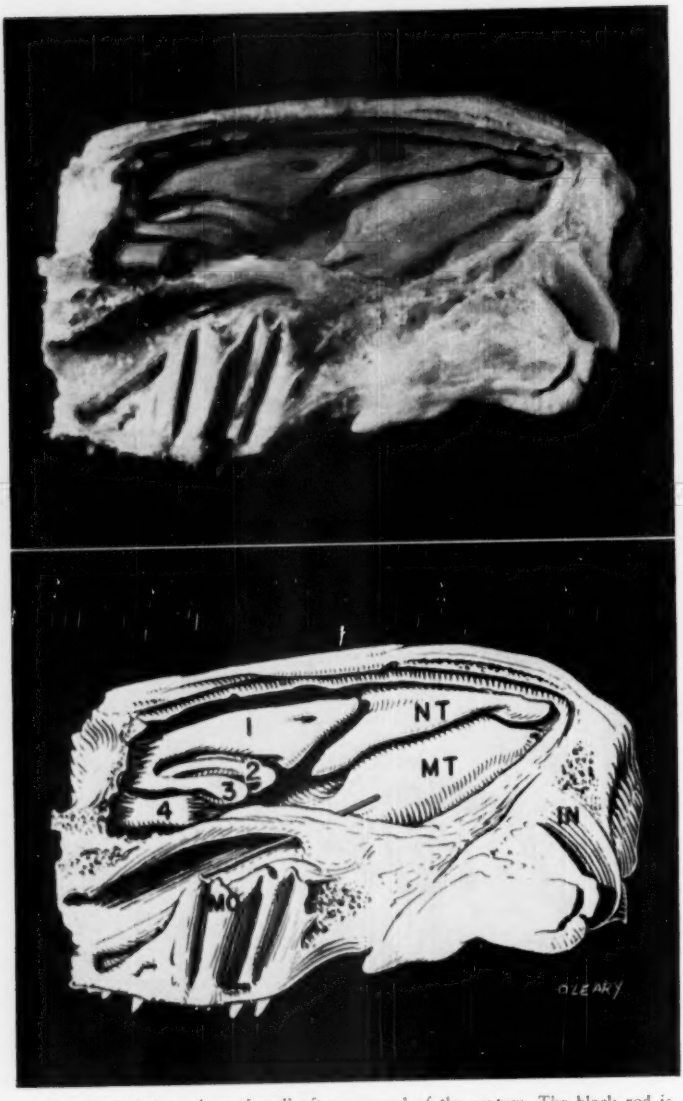


Fig. 2.—Left lateral nasal wall after removal of the septum. The black rod is placed in the left choana, leading into the subseptal part of the nasopharyngeal duct. *NT*, nasoturbinal; *MT*, maxilloturbinal; *1234*, endoturbinals; *IN*, incisor; *MO*, molars.

Figure 2 shows the left half of the nose after removal of the septum. A rod inserted into the choana demonstrates the position of this opening

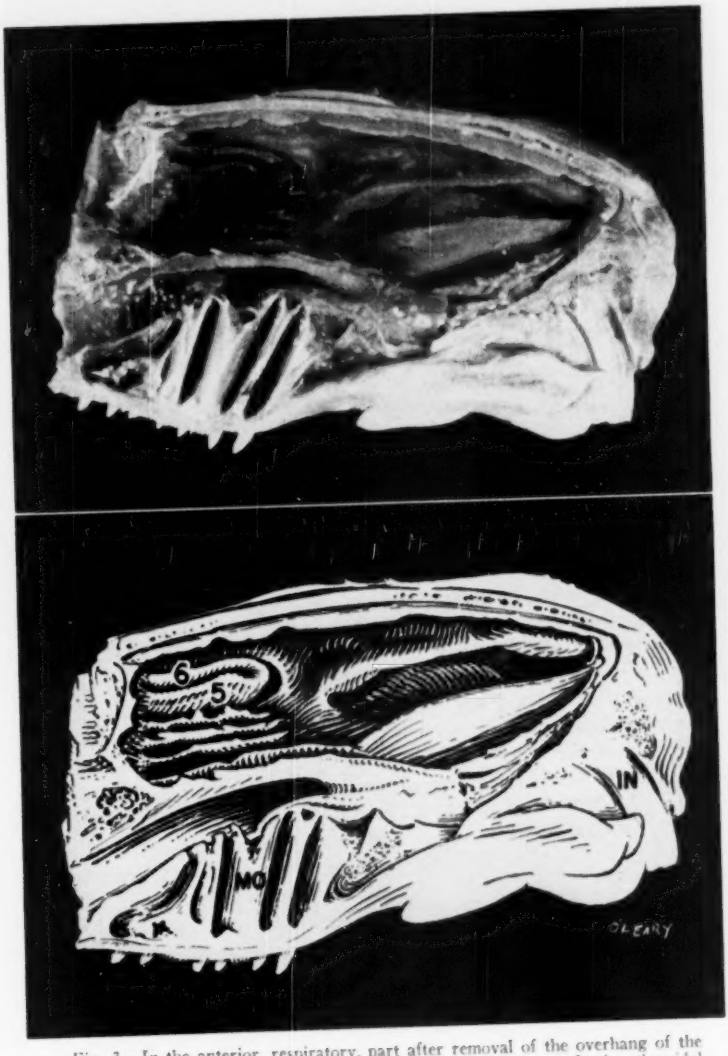


Fig. 3.—In the anterior, respiratory, part after removal of the overhang of the nasoturbinal and maxilloturbinal the anterior lateral recess is seen. In the ethmoidal part, after removal of the overhang of the endoturbinals, the ectoturbinals (*5,6*) are shown. *IN*, incisor; *MO*, molars.

as distinctly anterior to the ethmoid portion. The intact nasoturbinal, the maxilloturbinal and the four endoturbinals cover the lateral nasal wall. To be noted is the very intimate relation of the roots of the molars to the floor of the nasopharyngeal duct.

In figure 3, the overhang of the nasoturbinal, of the maxilloturbinal and of the four endoturbinals is removed. The two ectoturbinals are free; they are connected anteriorly by a pocket in which the mucous membrane cover is reflected from one to the other. No such connection is noted in the osseous scrolls, as will be seen in the frontal view.

Finally, in figure 4, after removal of the overhang of the ectoturbinals, the roots of all eight turbinals are seen. Laterally from them two recesses become visible. One is situated laterally from the nasoturbinal and the maxilloturbinal, and a deeper one lies behind the roots of the ectoturbinals. The latter is termed here "posterior lateral recess" and is a significant space. This recess was considered by some investigators to represent the maxillary sinus, which, however, is not found in the guinea pig.

The remaining photomicrographs, taken with a low magnification, represent a series of frontal sections starting from the nasal vestibule and ending with the cul-de-sac, the posterior extremity of the ethmoid portion. First (fig. 5 *A*), the broad and flat cross section of the respiratory part is seen with its anterior narrow dip reaching between the incisors; this lower part is even considerably deeper where the plane of the duct of the vomeronasal organ is reached (fig. 5 *B*). At this level the main nasal duct is an uninterrupted vertical passage with a narrow opening between the downward curving nasoturbinal and the upward curving maxilloturbinal. Where the vomeronasal organ (fig. 5 *C*) terminates, the lower edge of the septum becomes a slight bulge carrying an enormously developed tuberculum septi. The first endoturbinal is seen in the form of a ring-shaped cross section. The lateral nasal wall carries a thick glandular layer in its mucosal lining. In figure 5 *D*, the septum, at the border of the respiratory and the ethmoid portions, is completely disconnected from the hard palate, which carries here a very conspicuous layer of lymphoid tissue. Laterally, with a roughly triangular cross section, the nasolacrimal ducts are shown surrounded by a thick layer with cavernous spaces. In figure 6 *A* with full formation of the terminal laminas the ethmoid portion shows its complete contours. Above the nasolacrimal duct, the posterior lateral recess seems to be closed completely on the right side, thus simulating a maxillary sinus; however, on the other side it is shown as a mere recess connected with the main meatus by a long and narrow passage. This recess is better seen in figure 6 *B*. Here the four endoturbinals are shown. The two lower ones arise with a double root from the lateral wall. The two

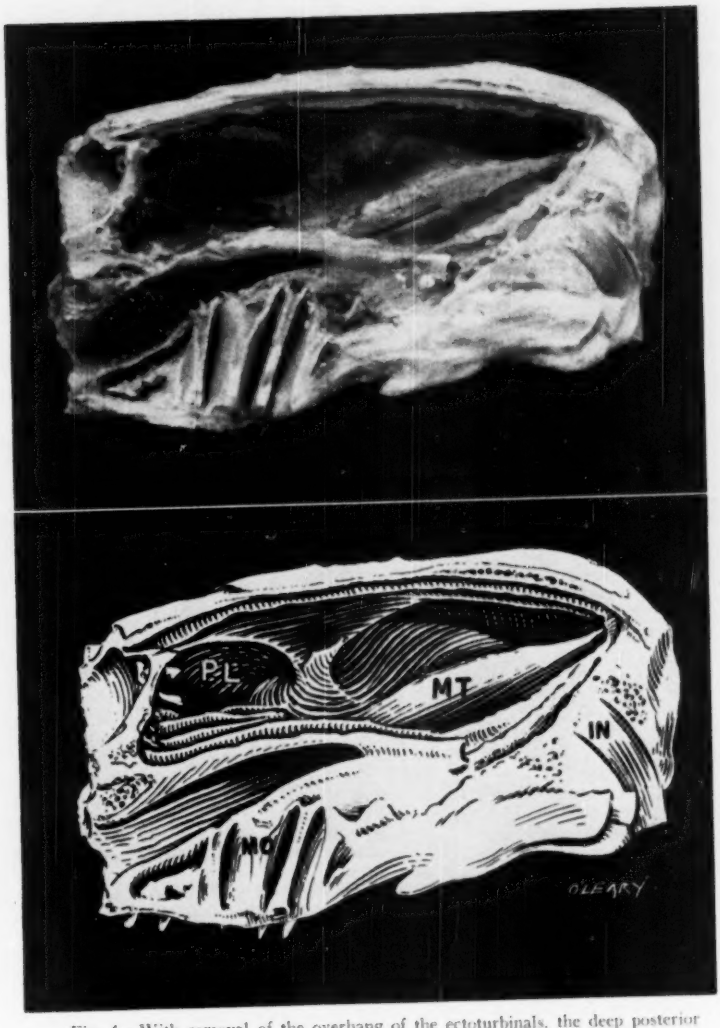


Fig. 4.—With removal of the overhang of the ectoturbinals, the deep posterior lateral recess (*PL*) is seen. *MT*, maxilloturbinal; *IN*, incisor; *MO*, molars.

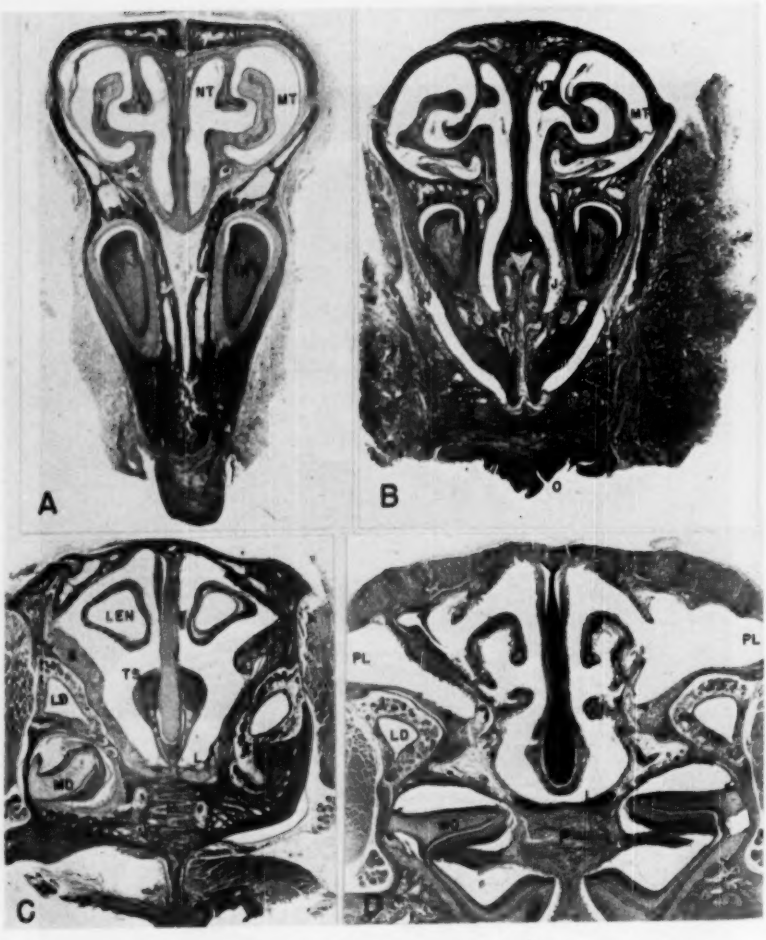


Fig 5.—Series of frontal sections (× 3).

A, region immediately behind the vestibule; cross section in the form of a T.

B, section from the plane of the center of the vomeronasal organ. The respiratory part sinks deep between the backward-curving incisors.

C, region of the tuberculum septi, marking the boundary between respiratory and olfactory (ethmoid) parts.

D, under the bulky edge of the septum, the subseptal window opens. In this section there is a spacious posterior lateral recess and a huge cross section of the nasolacrimal duct.

In this and the following illustrations *AL* indicates the anterior lateral recess; *D*, subseptal duct; *G*, glandular mass; *IN*, incisors; *J*, vomeronasal organ (Jacobson); *L*, lymphoid mass; *LD*, nasolacrimal duct; *MO*, molars; *MT*, maxilloturbinal; *NT*, nasoturbinal, *O*, oral cavity; *P*, palatal process of maxilla; *PL*, posterior lateral recess; *T*, terminal laminas; *TS*, tuberculum septi; *V*, nasal vestibule; *W*, septal window; *1.EN*, first endoturbinal; *1,2,3,4*, endoturbinals; *5,6*, ectoturbinals.

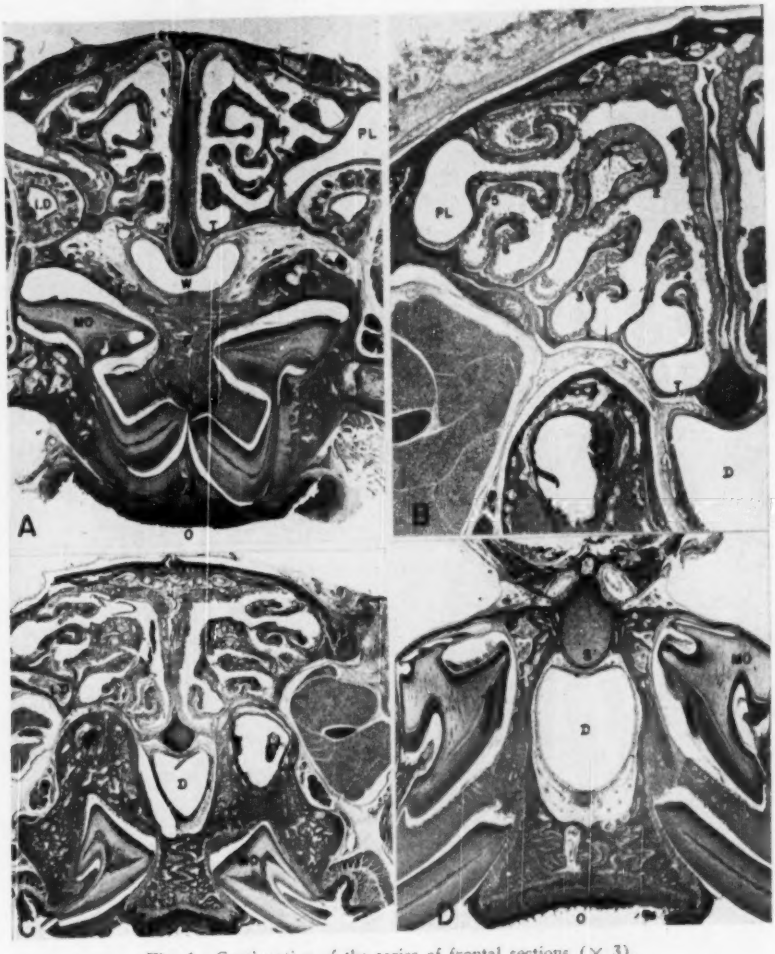


Fig. 6.—Continuation of the series of frontal sections (× 3).

A, septal window wide open, with U-shaped cross section; above the terminal laminas, ethmoturbinals; posterior lateral recess, seemingly closed at one side.

B, plane somewhat behind *A*: long and narrow entrance to the posterior lateral recess, flanked here by the first endoturbinal and the first ectoturbinal; subseptal duct, with slightly heart-shaped cross section.

C, ethmoid part, near the fundus, with the posterior corner of the posterior lateral recess; triangular cross section of the subseptal duct; nasolacrimal duct, on one side, in the horizontal part of its course.

D, deepest portion, cul-de-sac, of the ethmoid part, right and left from the bulky septal edge; above, endocranium; subseptal duct enlarging to nasopharyngeal duct.

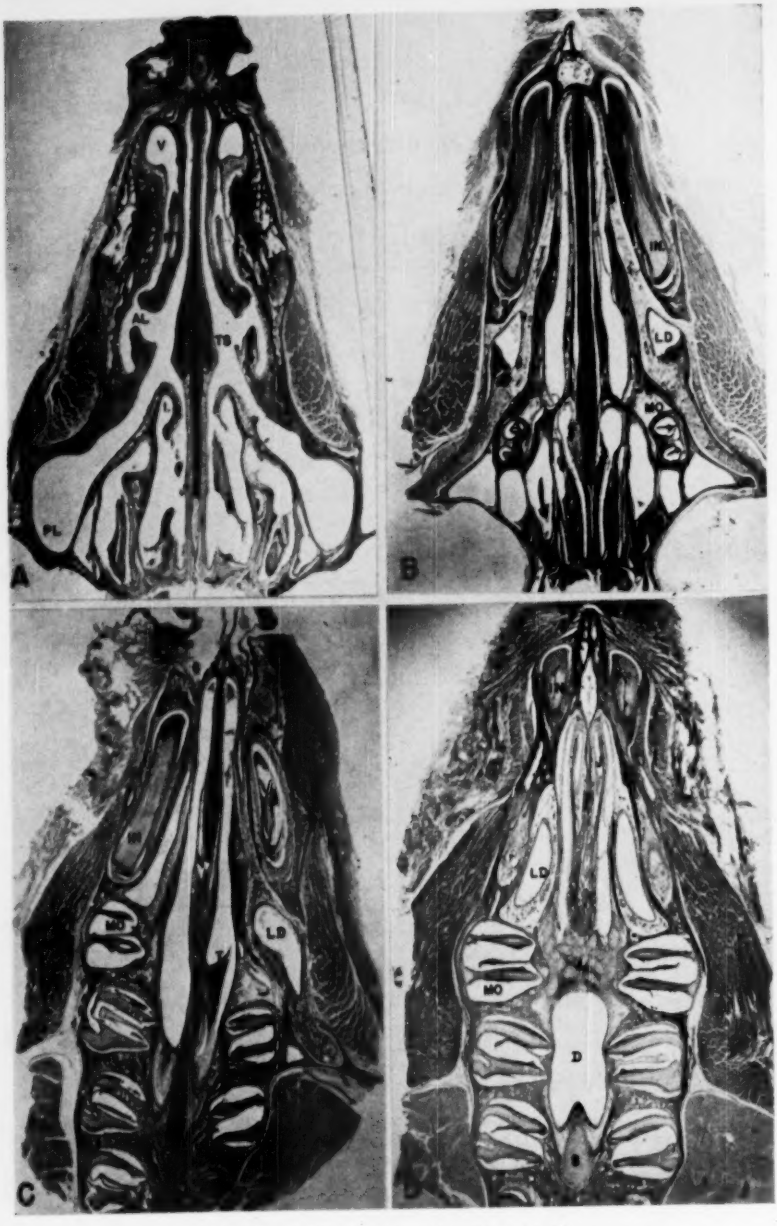


Fig. 7.—Series of horizontal sections (× 2).

A. At the level of the tuberculum septi, the region adjacent to the vestibule is seen. The anterior lateral recess here forms a shallow depression, while the posterior lateral recess is spacious, reaching the posterior extremity of the nasal capsule.

B. The respiratory part is twice as long as the ethmoid. Between the backward-curving incisor and the molars the nasolacrimal duct fills out, with its cavernous body, the diastema.

C. The shelf, consisting of the terminal laminas, is seen at one side as the floor of the ethmoid part, while at the other side the choanal opening is already forming.

D. The subseptal duct is seen between the rows of the molars, their roots reaching sometimes the mucosal lining of the duct. Anterior to it are the conspicuous central lymphatic mass and the anterior half of the vomeronasal organ. The nasolacrimal duct runs along the lateral wall of the respiratory part.

ectoturbinals, hidden from the main cavity, are located between the first and the second endoturbinals. Figure 6 *C* shows the posterior end of the posterior lateral recess, with a somewhat broader communication running into the main cavity. The two laminas of the frontal bone do not separate to form a frontal sinus. The nasolacrimal duct is seen on its way outward from the nasal capsule under the lateral part of the ethmoid portion. In the last picture of this series (fig. 6 *D*) the nasopharyngeal duct is definitely formed; a slight remnant of the lymphoid layer which was found compact in sections farther in front, is seen at the bottom. High up is observed the last vestige of the cul-de-sac of the ethmoidal portion.

*Microscopic Observations**

- In the nasal passages
  - Borderline, between physiologic and pathologic
    - Homogeneous secretion: mucus plus transudate
      - Scarce amount, scattered over several meatuses (6)
      - In all passages, including lateral recesses (2)
      - Restricted to posterior lateral recess (2)
    - Fibrin
      - Scattered strands (5)
      - Strands in every meatus (2)
  - Pathologic
    - Homogeneous secretion: mucus plus transudate
      - Mixed with blood, in nares (9)
      - Mixed with desquamated epithelial lamellas (3)
    - Fibrin
      - Enmeshing desquamated epithelial lamellas (4)
    - Suppuration; pus
      - In scattered clumps (2)
      - In clumps, surrounding destroyed epithelium (4)
      - Osteophyte formation in suppurating masses (7)
    - Fungus colonies (1)
    - Foreign material of plant origin (1)
- In the tissues
  - Pathologic findings
    - Subepithelial edema (1)
    - Excessive lymph cell infiltration in all subepithelial layers (7)
    - Excessive epithelial desquamation with formation of cholesteatomatous masses (7)
    - Isolated, "primary" cholesteatoma in the skin of the nares (1)

* The figures in parentheses indicate the number of animals in which the condition was present.

A series of four horizontal sections (fig. 7), starting at the top and proceeding downward, supplement the previous series from a different perspective. In figure 7 *A* the nasal vestibule is shown as an enlargement of the main meatus. The tuberculum septi is already well developed in this plane. The anterior lateral recess, located laterally from the nasoturbinal and the maxilloturbinal, forms a large space with wide opening. Figure 7 *B* shows the diastema (interalveolar space) between the gnawing teeth (incisors) and the grinding series (molars). No premolars are present. The incisors are seen here in their long backward-curved portion. Figure 7 *C* shows on one side of the nasal cavity the formation of the terminal (transversal) lamina of the ethmoid, which will build the floor of the ethmoidal portion: the latter, located entirely

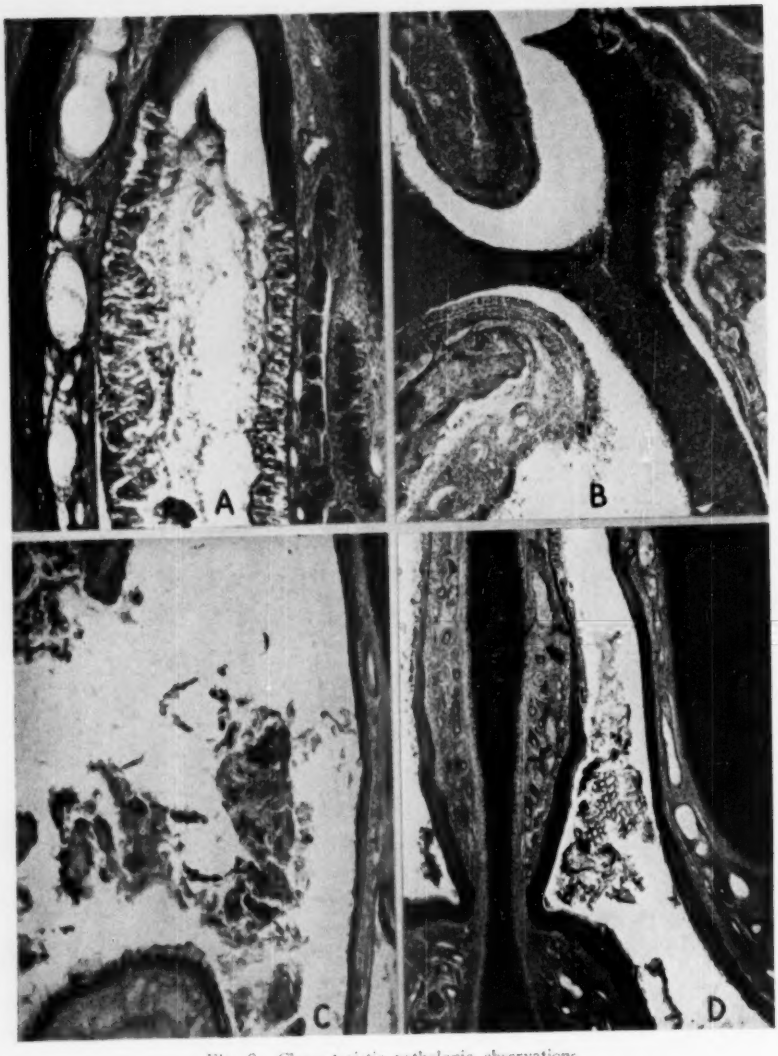


Fig. 8.—Characteristic pathologic observations.

A, acute catarrh with beginning dissolution of the respiratory epithelium; squamous epithelium of the vestibule intact. Note the sharp boundary between the two kinds of epithelium.

B, nasal passages filled with massive pus; partial destruction of the epithelium.

C, clumps of pus with formation of osteophytes.

D, foreign body, inhaled plant material, surrounded by reactive cell masses; epithelium, squamous and respiratory, intact.

behind the respiratory part. Figure 7 *D* shows the nasopharyngeal duct with a massive layer of lymphoid tissue in its anteroinferior wall. The roots of the molars are divided by a very thin bony partition from the lumen of the duct, while the nasolacrimal duct runs across the diastema.

Pathologic Findings.—In some instances it is hard to determine whether a certain picture represents normal secretory or vasomotor conditions or whether it represents a decidedly pathologic process. Tabulation of pathologic and borderline findings (table) show their character and frequency.

It is important to remember that in the literature similar conditions have been mentioned as experimentally produced abnormalities. The wide nasolacrimal duct was in several instances the site of pathologic conditions; massive pus was present in its lumen, while conspicuous accumulations of lymphatic tissue were seen under the mucosal lining with deep penetration into the cavernous layer.

Four characteristic conditions are reproduced in figure 8.

Figure 8 *A* is from an area near the anterior cul-de-sac. The squamous epithelium lining the anterior part of the respiratory portion ends in this area, as elsewhere, abruptly. This squamous epithelium has its own pathologic change, expressed by more or less massive desquamation that, in smaller quantity, represents a normal finding. The respiratory epithelium, though all its layers can be identified, is in a process of dissolution such as occurs in acute catarrh, in the course of which, as is known, destruction and replacement may take place within a few days.

The nasal passages can be filled solidly by pus (fig. 8 *B*), with the underlying mucosa partly intact, partly on the way toward dissolution.

The formation of osteophytic masses within clumps of suppurative material (fig. 8 *C*) is a sign that the process is of longer duration. In these chronic conditions the mucosa was not damaged to the extent seen in acute processes, a certain degree of equilibrium having established itself.

The inhaling of foreign material, as represented by plant particles, is not infrequently observed (fig. 8 *D*). These particles are sometimes surrounded by granulating masses or debris that could not be ejected by simple blowing.

On one occasion a rare formation was encountered: A primary cholesteatoma was found in the skin of the premaxilla, completely encapsulated and without any sign of a collateral reaction in the surroundings.

COMMENT

Some comprehensive notes on anatomic characteristics are given here, as knowledge of them goes far in helping to avoid pitfalls when evaluating experimental results.

The turbinal apparatus shows frequent variations in its disposition in the ethmoid part, while position and size of the nasoturbinal and the maxilloturbinal are fairly constant. Four endoturbinals and two ectoturbinals are present. The latter ("conchae obtectae") are located between the first and second endoturbinals. As one or the other of the ectoturbinals may arise with twin roots, in this circumstance one gets the impression that three ectoturbinals are present. The third and fourth endoturbinals are simple scrolls; the second is usually divided into two scrolls. The second and third endoturbinals were found united at their free ends into one mushroom-shaped cushion with the olfactory mucosa running smoothly over the top.

The septal window, representing the confluence of the two inferior meatuses of the respiratory portion immediately behind the vomeronasal organ, is present here in the same form as in the rat. The tentlike antechamber, covering the nasal opening of the nasopharyngeal duct, is formed under the terminal (transversal) laminas as in the rat; the cross section of the subseptal section of the nasopharyngeal duct is reniform, butterfly-shaped in its frontal area with the cartilaginous rod of the septal edge cutting deep into its lumen. As in the rat, the presence of this transseptal communication makes illusory the use of one half of the nose as "control" while experimenting in the other with solutions.

In spite of this permanent opening, spontaneous pathologic conditions can be restricted to one side, e. g., desquamated lamellas in masses suggesting cholesteatomas. Artefacts, such as separation of the mucosa or merely of the epithelium produced probably during the act of fixation, are restricted sometimes to one side—another warning that drugs introduced equally into the two nares can affect the two nasal halves in very different ways. In some instances, separation of the soft parts was limited to the schneiderian membrane; in others, the latter was intact with the respiratory epithelium suffering more. Separation of the soft tissues is the most frequent artefact to be avoided in the course of the histologic preparation.

The enormous nasolacrimal duct is a very conspicuous element in the anatomic picture. It hugs the contours of the nasal cavity, taking part in its pathologic processes or showing isolated pathologic changes. Several times it was found filled with pus, while accumulations of lymph cells penetrating into the depth of the huge cavernous apparatus may prove to be a normal condition. The mucous membrane carried high papillae. Its detailed description was given elsewhere.[4a]

The peculiarity of the nasal cavity of the guinea pig consists in its division into a horizontal superior and a vertical inferior part. They meet in the respiratory half to form a T, while in the ethmoid half the

4a. Kelemen, G.: The Nasolacrimal Duct of the Guinea Pig, J. Laryng. & Otol. **64**:131-134 (March) 1950.

vertical portion disappears completely. Here (in the posterior half) a broad, elliptic cross section replaces the narrow, high passages seen in the rat's nose. No narrow, deep cul-de-sac is present posteriorly as in the rat. The nasal cavity of the guinea pig is made even roomier by the absence of maxillary sinuses, their space being included in the form of recesses into the main cavity. There is an anterior lateral recess, lateral to the nasoturbinal and the maxilloturbinal, and a posterior lateral recess in the external posterior corner of the ethmoid part. Both can be blocked. In one instance the anterior lateral recess was found covered by the soft parts of the nasoturbinal and the maxilloturbinal which were in contact. The narrow duct leading into the posterior lateral recess can be blocked when the cavernous tissue of the surrounding turbinals is in a state of engorgement. The walls of the posterior lateral recess carry especially high papillae and a larger amount of goblet cells than does the epithelium in the main cavity, reminiscent in this respect of the conditions of the maxillary sinuses in other species.

Canaveris [5] was right in emphasizing the complete absence of a frontal or a maxillary sinus in the guinea pig.

The border between the stratified squamous epithelium of the vestibule and the respiratory epithelium is everywhere very sharp; the boundary line, however, shows wide variation. The squamous epithelium is the more resistant to pathologic agents; it shows, generally, merely desquamative processes. Edema, infiltration and other pathologic conditions of the nasal mucosa end at the edge of the respiratory epithelium. It is to be remembered in experiments that this "inert area," the area of the squamous epithelium, reaches far into the cavity, especially on the floor of the respiratory portion. In the ethmoid half olfactory epithelium covers the septum and the surfaces of all the turbinals.

Engorgement, the play of the cavernous tissue, can be observed as a regular phenomenon as well under the respiratory as under the olfactory epithelium in every combination. Frequently one surface of a turbinate shows maximally dilated and the other contracted vessels. The septum takes part in this process as, especially in its upper part, it has a distinct cavernous apparatus.

In the rich glandular apparatus two groups should be mentioned. One is the gland immediately behind the posterior, blind ending of the vomeronasal organ, the "terminal gland of Jacobson's organ" according to Broman.[6] As it borders on the orifice of the nasopharyngeal duct, it may acquire a role in the transmission of pharyngeal infections. Another gland forms a very conspicuous mass flanking the lower half of the

5. Canaveris, R. G.: Los senos paranasales en algunos mamiferos, Rev. brasil. de oto-rino-laring. **15**:57-83 (March-April) 1947.

6. Broman, I.: Ueber die Entwicklung der konstanten grösseren Nasenhöhlendrüsen der Nagetiere, Ztschr. f. d. ges. Anat. **60**:439-586, 1921.

border between the two main sections of the nasal cavity. This mass probably is identical with Stensen's gland which surrounds the maxillary sinus and in the guinea pig is far less developed than in species that possess a maxillary sinus.

The glandular conglomerate of the tuberculum septi is very conspicuous and reaches its richest development in the frontal plane of the opening of the septal window. On the opposite lateral wall a glandular mass juts into the lumen, and between the two a kind of isthmus is formed. At this level the transition between the respiratory and ethmoid part is well marked. The lumen of the cavity here is almost empty, containing merely the ring-shaped cross section of the first endoturbinal without attachment to the walls. A smaller "tuberculum septi," consisting of a glandular layer, is found very near the highest part of the septum.

Groups of lymphatic follicles are very conspicuous and are seen in characteristic locations: on the lateral wall of the respiratory portion, opposite the vomeronasal organ; on the floor of the septal window, where it is continuous with the glandular mass on the lateral wall. As in the rat, this mass of very characteristically located lymphatic tissue within the nasal cavity awaits exact observation and description, as, apparently, it has escaped the attention of investigators. Septums are seen dividing the lymphatic mass into nodules. The overlying epithelium is in some areas reticulized and disappears along a wedge-shaped stretch under the transmigrating lymphocytes.

Vessels running between the alveoli of the molars and the nasal cavity represent a potential source of transmission of infection. No pathologic changes were observed in the osseous capsule. The dental formula of the guinea pig is $I\ \frac{1}{1}\ C\ \frac{0}{0}\ M\ \frac{3}{4}$.

Two typically reversible conditions were frequently seen: edema of the submucous layers, with separation of the soft parts from the underlying bone, elevating the mucosa in the form of a vesicle, and infiltrations with lymph cells in irregular locations, sometimes reaching considerable dimensions.

Some remarks may be added to compare data of this study with previous descriptions. Wiedemann was correct in his explanation (cited by Zuckerkandl [7]) of the narrow inferior half of the anterior respiratory portion: The lateral walls are here compressed by the large, backward-curving incisors which leave little space between them. This gives the cross section of the anterior part its very characteristic form. On the other hand, Zuckerkandl's [7] description of the posterior half, as a narrow space though of considerable length, must be corrected. It corresponds

7. Zuckerkandl, E.: Das periphere Geruchsorgan der Säugethiere, Stuttgart, F. Enke, 1887.

to conditions as seen in the rat, but the nasal cavity of the guinea pig is built in a quite different way: The ethmoid part is a box with its largest diameter running laterolaterally. This disposition is accentuated by the inclusion of the roomy posterior lateral recess ("recessus posterior superior" in the nomenclature of Seydel [8]) into the ethmoid part. As it is of great importance from the viewpoint of clearance, this general form is the outstanding characteristic of the nasal cavity of the guinea pig. Normal secretions, as produced incessantly by the mass of the ethmoturbinals, do not escape through the respiratory passages and the nostrils, as the choanal opening is situated in front of the ethmoid capsule. These secretions move forward and have to drip over the shelf of the terminal laminas to reach the choanal region. The choanal openings, as in the rat, face each other, at an angle of 45 degrees to the longitudinal axis under the terminal laminas. They unite here to form the subseptal part of the nasopharyngeal duct. The secretions of the respiratory part also are directed mostly toward this exit. In this way the nostrils play a minor role in clearing the respiratory area and no role at all in clearing the ethmoid area. The ethmoid area and the upper half of the respiratory area converge funnel-like to the region of the terminal laminas. Through intercalation of the subseptal duct the pharyngeal orifice is pushed anteriorly almost into the center of the nasal cavity, and the flow of the secretions is directed from the respiratory part anteroposteriorly and from the ethmoid part posteroanteriorly. Paulli [9] emphasized that the bizarre passages formed by the ethmoturbinals have nothing in common with the human ethmoid cells.

While the large capsule of the superior part of each half is drained in an ideal way, the deep and not easily accessible lower meatus retains secretions more readily; in this way they may be brought into a more prolonged contact with the vomeronasal organ, favoring the chemical analysis performed by the latter.

The roominess of the main capsule, with its excellent drainage conditions, may account for the scarcity of pathologic findings, which becomes very conspicuous in comparison with conditions as found in the rat. For the same reason, histologic fixatives fill the cavity much more easily, with the result that much less separation of soft parts is seen and the role played by this disturbing artefact is less important than in the rat. Though the elimination via the nostrils is insufficient, trapped foreign bodies (mostly inhaled plant particles) are expelled much more easily through the choanae and play a minor role.

8. Seydel, O.: Ueber die Nasenhöhle der höheren Säugetiere und des Menschen, Morphol. Jahrb. **17**:44-99 (March) 1891.

9. Paulli, S. Ueber die Pneumaticität des Schädels bei Säugethieren, Morphol. Jahrb. **28**:147-178 (Dec.) 1899; 179-251; (June) 1900; 483-564 (Sept.) 1900.

The accessibility of the spaces of the nasal cavity of the guinea pig provides opportunity for better drainage and consequently less pathologic change. This laboratory animal, therefore, seems to be preferable when it comes to experiments with intranasal administration of drugs. The absence of pathologic conditions in and around the olfactory membranes makes it a safer object in psychologic experiments when marking the true path of the maze with an olfactory trail or observing discriminatory response with the help of olfactory cues.

The use of one half of the nasal cavity as against the medicated other half is quite as senseless in the guinea pig as in the rat; the physiologic communication through the large septal window permits the mixing of secretions, or of any other fluid coming from the two halves of the nasal cavity, long before they reach the points of elimination. Finally, complications by an isolated and disturbing sinus disease are excluded in the guinea pig, because accessory sinuses are entirely absent.

As was stated in another instance by Rüedi,[10] the guinea pig equally deserves to be called the "ideal experimental animal" when it comes to work within its nasal cavity.

SUMMARY

In (1) intranasal experimentation with drugs introduced into the nasal cavity and in (2) comparative psychology working on the basis of olfactory cues, preference is to be given to the guinea pig rather than the rat. The roominess of the nasal cavity, with absence of accessory sinuses, results in less spontaneous pathologic change and more intimate contact of liquid or gaseous materials with the mucous membranes of the respiratory and olfactory parts. One half of the nasal cavity cannot be used as a control against the medicated other half because the two halves communicate through a physiologic septal window.

10. Rüedi, L.; Furrer, W.; Escher, F., and Lüthy, F.: Toxische Wirkungen des Streptomycins, Acta oto-laryng., 1949, supp. 78, pp. 66-77.

MANAGEMENT OF NASAL ALLERGY

SOLOMON SLEPIAN, M.D.
Chief, Allergy Clinic, Brooklyn Eye and Ear Hospital
BROOKLYN

THE NOSE and throat specialist now realizes that the patient with so-called vasomotor rhinitis, or nasal allergy, is best treated by complete allergic management rather than by an attack on the nasal mucosa with chemical caustics, cautery, ion transfer or other drastic methods. The most satisfactory way of managing these patients is by complete cooperation between the allergist and otolaryngologist. From my experience in the Brooklyn Eye and Ear Hospital Clinic, I have gained the impression that better results are obtained when the otolaryngologist elicits the aid of the allergist in caring for these patients than when he attempts to treat the allergic problem by himself. The surgeon is trained to recognize pathologic conditions and to effect a cure quickly by his surgical skill. He is by temperament, therefore, impatient with slow, drawn-out and, at times uncertain methods used in managing the allergic condition and often loses interest. On the other hand, the allergist likewise must frequently elicit the aid of the surgeon to correct abnormalities which may, at times, retard or prevent the patient from obtaining maximum comfort from his allergic treatment.

This discussion will concern itself with the case of true allergy, in which there is a specific sensitization to substances which may have been inhaled, ingested or absorbed from within the body. There are many instances of coryza or rhinitis in which the clinical picture resembles the allergic state but the underlying cause is not allergy. Chemical irritants or fumes, excessive heat or cold, nasal obstruction of various kinds, hormonal disturbances, infections—bacterial or viral—may give rise to symptoms resembling allergy.

The immunology of the allergic state very briefly is about as follows. In the allergic subject specific antibodies develop to the substance or substances to which he is allergic. These are known as atopic reagins. These reagins, at times, become attached to tissue cells and act as mediators to bring about a linkage of antigen to these cells. When this

Presented at the Clinical Conference, Department of Otolaryngology, Brooklyn Eye and Ear Hospital, Jan. 10, 1950.

linkage occurs, a reaction takes place and a chemical substance resembling histamine is liberated. The cells to which the antibody becomes attached is known as the shock tissue, or shock organ. In nasal allergy, the antibodies become attached to the nasal mucosa. There may also be free antibody present in the blood and tissue fluids of the nose.

The exact site of attachment is not definitely known, but there is strong evidence that it may be in the vascular bed and not in the smooth muscle or epithelial layer. The reason that the nose and upper respiratory passages are usually predominantly involved in the allergic subject may be that the inhaled substances reach these sites first and in greatest concentration. These tissues will consequently have the greatest concentration of antibody and therefore be the site of greatest reaction.

The reagin or antibody that is concerned in allergy is different in its behavior from the antibodies commonly producing immunity after infectious disease or the antibodies that have to do with blood typing, etc.

From a comprehensive study of the three major types of allergy, namely, animal anaphylaxis, serum disease and asthma, three main types of antibody are recognized. There is a skin-sensitizing antibody, a muscle-sensitizing antibody and a precipitin. A thermostabile blocking antibody produced by treatment is also recognized, and there may be others.

To recapitulate—the immunologic mechanism seems to be an antigen cellular antibody reaction. Atopic reagin + antigen (atopin) liberates histamine, which causes increased capillary permeability → edema → wheal.

All the known allergic conditions seem to group themselves on the basis of the presence or absence of one or the other type of antibody or combinations of these antibodies. The antibody involved in nasal allergy is the skin-sensitizing antibody.

Allergic conditions in general fall into two large groups: spontaneous allergy—or, as it is sometimes called, the immediate wheal type—and induced allergy, called the delayed reaction type.

In spontaneous allergy, which involves about 10 per cent of the population, heredity plays a definite part. These patients form the group in which no purposeful preliminary sensitization with an antigen seems necessary. The tendency is there from birth. This is the group to which the patients with asthma, urticaria and hay fever belong. They all demonstrate a skin-sensitizing antibody, at times, without apparent previous contact. Skin tests elicit immediate wheal reactions.

The artificially induced type of allergy may really be considered a normal physiological condition. Almost anybody who receives an injection of horse serum will subsequently be sensitive to horse serum. The skin reaction to tuberculin in persons who at one time harbored the disease and some of the contact dermatitides are allergic states in which

heredity need not play a part. The skin test reaction usually is of the delayed type, appearing in about twenty-four hours, in contrast to spontaneous allergy, in which the reaction occurs in a few minutes. Skin sensitizing antibody is demonstrated in these cases after a period of incubation. Most of the cases of nasal allergy belong to the spontaneous or immediate wheal type except possibly the cases of bacterial allergy.

Most chronic diseases of the nose and paranasal sinuses are due to allergy. Shambaugh has stated that in at least 70 per cent of chronic infections of the sinuses and 90 per cent of chronic nasal infections an underlying allergic factor is responsible for the chronicity.

At times the diagnosis of allergy is made by exclusion. Once it is established that the coryza with which one is dealing is not due to systemic disease, syphilis, tuberculosis, endocrinopathy or some local condition, the diagnosis of allergy is entertained.

Because of the many factors which must be taken into consideration, it becomes difficult to classify the cases of nasal disease into groups on an etiological or pathological basis. Some divide respiratory allergy into the intrinsic and extrinsic types. In the extrinsic group are included those cases in which the allergy is caused by inhalants, ingestants or contactants. The intrinsic group includes those cases in which no apparent extrinsic causes exist and which may be caused by such intrinsic factors as endocrine disturbances or foci of infection.

Other observers have classified the cases on the basis of the skin reaction—for example, those with positive skin reactions similar to the immediate wheal type; to this class belong the cases of seasonal hay fever.

The other group is that with negative skin reactions, including the cases of intrinsic and of bacterial allergy.

To cover the subject completely and take up the various clinical types of nasal allergy is beyond the scope of this discussion. According to Hansel, it would comprise a consideration of (1) seasonal hay fever, complicated or uncomplicated by other manifestations or sensitivities; (2) seasonal hay fever with perennial symptoms in greater or less degree, with or without other manifestations; (3) nasal allergy without hay fever caused by food, inhalants or a combination of food and inhalants complicated or uncomplicated by other manifestations; (4) nasal allergy with negative skin reactions for which no cause is determined, and (5) bacterial allergy.

Let us for a moment consider nasal allergy caused by foods, inhalants or a combination of the two, complicated or uncomplicated by infection and without seasonal hay fever.

The symptoms usually complained of are well known. They are sneezing, itching of the nose and eyes, nasal obstruction, lacrimation,

nasal discharge and loss of the sense of smell in some cases. These symptoms may be continuous or occur periodically in various combinations.

A comprehensive history is the most important diagnostic aid in solving some of the problems in allergic coryza as well as in other forms of allergy. The family history should be gone into carefully and inquiries made as to allergic disease of both the ascending and the descending lineage. It is not sufficient to simply ask whether there is allergy in the family. In many cases the answer at first might be no. But if one asks specifically whether any one in the family has had hay fever, asthma, hives, eczema, migraine headaches or intestinal allergy and then inquires whether the father, mother, grandfather, grandmother, uncles, aunts, cousins, brothers or sisters have any of these diseases, the answer is often changed.

The habits and mode of living of the patient often give a clue to the offending allergen. Eating habits, types of clothing worn, environment at home, presence of pets, types of furniture and drapes, amount of linoleum in cases of sensitivity to flaxseed and use of insecticides are all important. The neighborhood in which the patient lives may be significant; proximity to manufacturing plants, pet shops, bakeries, stables, chicken markets should be inquired about. The environment at work and the nature of the industry should be considered. Hobbies may be a factor. Past illnesses may have a bearing, particularly when the symptoms of allergy follow a respiratory or other infection.

A complete history cannot be taken at one time. What my colleagues and I usually do is to take a working history at the first visit and continue the interview while the patient is being tested. In case of seasonal hay fever, the history is very often more reliable in planning the subsequent management than the results obtained by skin tests.

All patients should receive a complete physical examination to rule out systemic disease which might complicate the case. This is particularly important for children. At times the correction of a secondary anemia or an avitaminosis spells the difference between success and failure in treatment.

Rhinoscopic examination reveals pallor and swelling of the mucosa with possibly polypoid changes or true polyps. There is usually a thin watery discharge. With superimposed infection, the discharge may be mucopurulent and the mucosa may have a more reddened appearance. Roentgen investigation of the paranasal sinuses is inadvisable while symptoms are severe. The films at that time usually show some degree of cloudiness due to a transitory edema of the mucosa which may disappear in a very short time. A much more valuable impression of the chronicity of the changes in the sinuses may be obtained after adequate allergic management.

Laboratory examinations, except for nasal smear and blood count, are of no help in the diagnosis of nasal allergy. The nasal smear aids in differentiating true allergic rhinitis from nonallergic nasal irritation. In the patient with allergic rhinitis one finds an eosinophilia of the nasal secretions; this is present in the patients with allergy of food or inhalant origin as well as in patients with bacterial allergy. Eosinophils may appear at all times in the nasal discharges of allergic patients, even those temporarily free of symptoms. The presence of large numbers of neutrophils indicates a superimposed nasal or sinus infection. As the infection subsides, usually in 10 or 15 days, the neutrophils gradually disappear and the eosinophils increase. The character of the discharge then changes from the mucopurulent to a watery mucoid consistency. A persistent absence of eosinophils in the nasal smear except in cases of complicating suppuration definitely excludes the possibility of allergy. Complete blood counts should be obtained in all cases. Eosinophilia helps in making the diagnosis. A red cell count and a hemoglobin determination to establish the presence of anemia is of great aid in subsequent management.

The skin test is of value in cases of the immediate wheal-reacting or spontaneous types of allergy. It is of no value in the presence of negative skin reactions, in which cases one must depend on the clinical history, trial and error therapy, elimination diets and food diaries.

The skin test depends on the presence in the skin and tissue fluid of a skin-sensitizing antibody, which has previously been mentioned. When an antigen is injected or comes into contact with specific antibody, a reaction takes place, as evidenced by the formation of a wheal and erythema of the skin. In testing for nasal allergy, I employ both the scratch and the intradermal method. The intradermal tests are more sensitive and give a greater number of positive reactions. There is an intranasal and ophthalmic method of testing as well, but these are seldom used. Risks of constitutional reactions are greater with the intradermal tests, and it is therefore preferable to use the scratch method for routine use and retesting the negative reactions by the intradermal method. We use a glycerinated extract for the scratch tests and an aqueous extract for intradermal tests. We test usually for the common inhalants and foods, comprising of about 40 or 50 items. Patients tend to be sensitive to types of allergens, which vary with each case; by that I mean that a patient may be sensitive to animal danders, the grasses, fruits, fishes, grains, etc. The sensitivity in any biologic group is more likely to be multiple than single; therefore, enough trustworthy information may be obtained by the selection of a few well chosen representatives of each biologic group of allergens. There is no need for subjecting a patient to three or four hundred tests with materials with which he rarely or never comes in contact. The forearm, arm or back may be used for

testing. By the scratch method from 12 to 25 tests may be made at one sitting. These are read in 12 to 30 minutes. By the intradermal method a smaller number are used. The reactions are read in eight to 15 minutes. A test is considered positive when it exceeds the control in the size of the wheal or erythema or both.

It must be realized that while the skin test is a valuable diagnostic procedure and simple to perform, it has its limitations. Some experience is needed for its proper application and interpretation.

Every case of allergy is an individual problem. Before a program of therapy is instituted, an appraisal should be made of all the information obtained from the history, local examination, laboratory tests, skin tests and the various manifestations of allergy to be dealt with in the patient.

Uncomplicated seasonal hay fever may be diagnosed almost entirely from the history alone, and the treatment is more or less routine.

The best method of treatment is still desensitization, or more accurately expressed, hyposensitization, by the preseasonal, the coseasonal or the perennial schedule. In the treatment of allergy due to known causal agents avoidance of the contact or gradual hyposensitization to the allergens produces much less physiological imbalance in the body than any other method of treatment. This statement is made in spite of the present trend to use antihistaminics as the only treatment for seasonal hay fever. The antihistaminics, so far as I know, do not prevent the patient with seasonal hay fever from lapsing into pollen asthma, whereas the parenteral treatment in many cases does prevent this complication.

Classified according to season, the patients fall into three great groups: those that have symptoms in the spring, those having symptoms in the early summer and those that have symptoms in the late summer.

For this part of the country, spring hay fever, occurring from early April to early June, is usually caused by tree pollen. The pollens of the grasses and plantain cause symptoms in the late spring and in the summer, the season extending from the middle of May to the end of June. The weeds are responsible for symptoms in the late summer and fall, from mid-August to early October.

For New York and its vicinity the most important tree pollens that have to be contended with are oak, hickory, birch, ash and beech, while elm, poplar, maple, walnut and alder are of secondary importance.

The important grasses are sweet vernal, June grass, orchard grass, red top and timothy.

Among the weeds, plantain and the short and the giant ragweed are the commonest offenders.

For treatment we employ an aqueous pollen extract, standardized by the total nitrogen method. The strongest solution employed is a 0.1 solution, which means 0.1 mg. of total nitrogen per cubic centimeter. This

is diluted 1 : 10 to a 0.01 solution and again to a 0.001 solution. If necessary, a 0.0001 solution may be made. We use Coca's fluid for making our dilutions. It is an alkaline fluid containing 0.5 per cent NaCl, about 0.3 per cent $NaHCO_3$ and 0.4 per cent phenol as preservative.

Tests are ordinarily made with a 0.01 solution on the outer aspect of the arm by making a tiny wheal intradermally after cleansing the skin with alcohol. The tests are read at the end of about 10 minutes and the cases classified according to the severity of the skin reaction. We consider a case as belonging to class A if the wheal produced is about twice or more the size of the original wheal, with definite pseudopod formation, an area of erythema and itching. A case is classified in class B if the wheal produced is about twice the size of the test wheal, is round

Dose Schedules for Treatment of Nasal Allergy

	Class A		Class B		Class C	
Dose No.	Solution	Dose, Cc.	Solution	Dose, Cc.	Solution	Dose, Cc.
1	0.001	0.1	0.0001	0.1	0.001	0.3
2	.....	0.2	.....	0.2	.....	0.6
3	.....	0.3	.....	0.4	0.01	0.1
4	.....	0.5	.....	0.7	....	0.2
5	.....	0.7	0.01	0.1	....	0.4
6	0.01	0.1	....	0.2	....	0.7
7	....	0.15	....	0.4	0.1	0.1
8	....	0.2	....	0.7	....	0.15
9	....	0.3	0.1	0.1	....	0.2
10	....	0.5	....	0.15	....	0.3
11	....	0.7	....	0.2	....	0.4
12	0.1	0.1	....	0.25	....	0.5
13	....	0.1	....	0.3	....	0.6
14	....	0.1	...	0.4	....	0.7
15	....	0.1	....	0.4	....	0.7

in outline and is surrounded by an area of erythema. In class C we put the cases with reactions less marked than those of class B.

The dose schedule followed for the various classes are given in the table.

In the preseasonal treatment, weekly injections are started about three months before the start of the season and continued up to the beginning of the season.

It might be said, however, that no schedule of dosage can be adhered to rigidly, for often modifications are found necessary owing to a variety of circumstances. Marked local or constitutional reactions, irregularity of the patient in keeping his appointments or change of extract will interfere with the schedule.

For the patients with uncomplicated nasal allergy found to be sensitive to inhalants or foods we try to change the environment by avoiding or escaping the exciting substance. This, of course, is a passive way of

averting the symptoms and does not attempt to produce an intrinsic change in the body to alter the allergic state. The symptoms return again whenever the patient comes into contact with the offending substance. With the present inadequate knowledge of the actual fundamental disturbance in the allergic state, this method of treatment is the simplest and gives better results than does the attempt to influence the inherited allergic predisposition by immunizing procedures.

Even for patients with mild disease, whose symptoms are not too annoying, a strenuous effort should be made to avoid continued intimate contact with the common inhalants and foods to which they are found sensitive. This is advocated from the standpoint of prophylaxis to avoid the development of asthma. Removal of pets, covering of bedding with antiallergic material, removal of rugs, drapes, stuffed articles of furniture and all other possible dust catchers should be the goal. In the case of foods, simple avoidance of the suspected food is sufficient.

House dust seems to be a common offender in many cases, and, as is well known, is very difficult to avoid.

I should like to call attention to a new preparation on the market for reducing the hazard of contact with house dust. It is advertised under the trade name of dust seal,* and it is described as an imperceptible liquid film that controls both contamination of the air with allergenic house dust within practical limits and the spread of bacterial inhalants. It can be applied to almost all types of household articles without harm. Full directions for its application and use are supplied by the manufacturer.

If the offending substance cannot be avoided, we resort to specific treatment. We do not desensitize against offending foods by the injection method. Some of the inhalants, however, may be employed for desensitization. The commonest ones used are pollens, dusts—stock or autogenous—orris and epitheliums such as chicken, duck, goose, dog, cat, horse and rabbit. Those occasionally used are silk, molds, especially Alternaria, and cow and goat epitheliums. Cotton seed and kapok are seldom used, and if used at all must be given very cautiously.

The general principle in the use of the extracts is to administer the largest dose of allergen that the patient can tolerate without aggravating the symptoms or initiating a constitutional reaction. When an optimum effective dose is reached, we maintain it at that point. Injections are at first given every five to seven days and then the intervals stretched to two, three or four weeks. As the schedule is being worked out, the patient will at times volunteer the information as to how long he has relief from his injection and if that time is exceeded symptoms recur. Hansel has advocated the use of dilute solutions starting with dilutions as low as 1 : 1,000,000,000 to 1 : 100,000 and increasing gradually. Others use much stronger solutions.

Bacterial allergy may be the underlying factor in many cases of allergic rhinitis in which there are negative skin reactions to the common inhalants, contactants or ingestants.

By bacterial allergy is meant human sensitization to bacteria or to the products of their growth. The locus of the bacteria may be anywhere in the body, not only in the upper respiratory tract or lung bed but in the mastoid cells, teeth, tonsils, bowel or gallbladder or anywhere else. The idea of bacterial allergy has been vigorously opposed in the past, but most investigators now accept the concept and there is considerable experimental evidence available to prove its validity.

Cases of bacterial allergy belong to the delayed reaction group, as contrasted to the immediate wheal group. Bacterial allergy must not be confused with the symptoms caused by an acute or subacute infection in the nose or sinuses. These two conditions may occur simultaneously, or the situation may be even more complicated by these states being superimposed on extrinsic allergy of the immediate wheal type, the type in which heredity plays a part.

Eosinophilia is observed in the nasal smear as well as in the peripheral blood of a patient sensitive to bacteria unless he is in the phase of acute infection, in which case neutrophils will predominate.

When bacterial allergy is suspected from the history, skin tests with individual stock organisms may be made. The reaction is a delayed one, as mentioned previously, and at times, does not reach its maximum for 24 to 48 hours. If no reactions are obtained by testing with the common organisms, autogenous vaccines are made by culturing all discoverable foci of infection and skin tests are carried out. The patient is then treated by injection with the organisms to which he is found sensitive.

For patients with typical nasal allergy uncomplicated by infection or polyposis operations on the nose are of no benefit. There are many, however, which require both allergic management and surgery to obtain maximum benefit.

Obstructing large polypi must be removed, with exenteration of the sinuses from which the polypi originate. Small polypi and polypoid changes of the nasal mucosa sometimes recede with allergic treatment. Patients suffering from chronically infected sinuses should be operated on.

Patients with deviated septums, spurs, very large turbinates or other nasal abnormalities who are still uncomfortable after a reasonable amount of adequate and proper allergic management should have the abnormality corrected surgically. Allergic treatment after the operation should be continued. The reason that results are, at times, disappointing after nasal operations, particularly sinus operations for removal of the focus of bacterial allergy, is that even very minute amounts of the

allergen remaining in the residual tissues after operation are sufficient to give marked symptoms of allergy. It is for this reason that surgery should be thorough and treatment continued for many months following the operation.

In the majority of cases if a definite and specific environmental cause is found to account for the symptoms improvement is almost immediate if the cause is removed; otherwise, the usual therapy that we employ results in slow improvement. The rate of improvement depends on a number of factors, the severity of the symptoms, the duration of the illness and the number of complicating factors of allergy in the patient.

Best results are obtained when there is intelligent cooperation by the patient in carrying out a program of therapy based on the findings in the diagnostic study. All food, contactants and inhalants to which the patient was found sensitive should be avoided. As a general rule, all pillows and mattresses should be covered with allergen-proof covers. The patient is advised to use nonallergic cosmetics and to remove all house pets. If there is an exacerbation of symptoms, a record should be kept of all the circumstances which might have contributed to the change, so that additional etiologic factors may be detected. Attention should be paid to general hygiene, excessive fatigue, exposure to cold, drafts or dampness, and contact with people who may be harboring infections of the respiratory tract should be avoided. A program of desensitization with the indicated substances should be instituted. Catarrhal vaccine is often helpful in cases with superimposed infection. For dust-sensitive patients, if relief is not obtained after a reasonable trial with a stock preparation, an autogenous house dust should be tried. The same holds true for patients treated with stock vaccine. If results are unsatisfactory, autogenous vaccines should be tried. High doses of vitamin A and C are recommended. The use of the decongestant drugs locally to obtain symptomatic relief if the patient is very uncomfortable may be necessary. Epinephrine, ephedrine, the amphetamine (benzedrine®) preparations or naphazoline (privine®) hydrochloride are used. This type of therapy should be withdrawn as soon as possible. There are dozens of other familiar drugs and preparations that may be used for symptomatic relief.

The latest weapon employed to combat the allergic syndrome is, as you know, the antihistaminics. Drugs belonging to this group fall into that newly discovered variety of substances known as metabolic antagonists. These are substances which are formed within the body or may be supplied to the body and compete with other substances biochemically. The biologic results produced by their reactions are opposite to those which would have resulted had their competitor entered the reaction.

The sulfonamide drugs are examples of such substances. They cause bacteriostasis by virtue of depriving the organisms of an essential material needed for growth, namely, paraaminobenzoic acid.

In the same way the antihistaminics are competitors for the allergic poison which is formed during an allergic reaction, in this case histamine or H substance. The antihistaminics combine with the H substance, thus neutralizing it and making it harmless to the receptive tissue.

It must be understood that these substances do not prevent the immunological reaction from taking place, but they simply gobble up the histamine, so to speak, after the reaction has occurred and prevent the histamine from acting.

There are many useful drugs on the market; I have a list of 17, but there must be many more. Tripelennamine (pyribenzamine®) hydrochloride, diphenhydramine (benadryl®) hydrochloride and chlorprophenpyridamine (chlortrimeton®) maleate seem to be the most useful. We usually prescribe pyribenzamine; if the side reactions are too annoying or if it does not produce the desired result we switch to one of the others.

We have by no means discussed all phases of the subject of nasal allergy. There are many cases which fall into the psychogenic group and should be managed accordingly. There are also other therapeutic procedures which were not mentioned and may be worth trying in individual cases. But on the whole, satisfactory results will be obtained if one follows the few suggestions made in the course of this discussion.

824 Linden Boulevard (3).

FIXATION OF THE VOCAL CORDS IN ACROMEGALY

JOHN K. GROTTING, M.D.
Fellow in Plastic Surgery, Mayo Foundation
AND
JOHN deJ. PEMBERTON, M.D.
ROCHESTER, MINN.

ACROMEGALY was described as a disease in 1885 by Pierre Marie.[1] Changes in the larynx have long been a part of the description of the syndrome. Several observers, Chappell,[2] Neufeld,[3] Jackson[4] and others, described hypertrophy of the mucous membrane, rotation and enlargement of the cartilages and other distortions in the larynx in cases of acromegaly.

Fixation of the vocal cords has not been described previously in this disease, and we were able to find only *2* previous reports which suggest it. Chappell[2] in 1896 described a case of acromegaly in which the patient had a narrow airway and died of asphyxia before he could be presented before a medical meeting. Jackson[4] reported a case in 1918 in which tracheotomy was necessary for a narrowed airway due to overgrowth of tissues.

Fixation of the vocal cords has been observed by us in *2* cases encountered in rapid succession and these cases have drawn our attention to this process. It was thought worth while, then, to review the records in 453 cases of acromegaly from the files of the Mayo Clinic. Only 65 patients had had laryngeal examinations, and in *7* of these patients fixation of the vocal cords was noted. We are presenting these *7* cases as evidence that in some cases fixation of the vocal cords should be included as part of the picture of acromegaly.

We prefer to refer to the finding as "fixation" of the vocal cord or "loss of motion" rather than as "paralysis," for we have no definite

From the Division of Surgery, Mayo Clinic (Dr. John deJ. Pemberton).

1. Marie, P.: Sur deux cas d'acromégalie: Hypertrophie singulière, non congénitale, des extrémités supérieures, inférieures et céphalique, Rev. de méd., Paris **6**:297 (April) 1886.

2. Chappell, W. F.: A Case of Acromegaly with Laryngeal and Pharyngeal Symptoms, J. Laryng., Rhin. & Otol. **10**:142 (March) 1896.

3. Neufeld, L.: Ueber Kehlkopfveränderungen bei Akromegalie, Ztschr. f. klin. Med. **64**:400, 1907.

4. Jackson, C.: Acromegaly of the Larynx, J. A. M. A. **71**:1787 (Nov. 30) 1918.

evidence of interference with the function of the nerves or their centers. It was thought at first that the enlarged thyroid gland, which is so commonly associated with acromegaly, produces compression or distortion of the recurrent laryngeal nerves and causes paralysis. The finding of intact nerves in the course of operation on the thyroid gland and the finding of fixation of the vocal cords in patients who had no thyroid enlargement prompted us to seek another explanation.

Loss of motion of the vocal cords, both bilateral and unilateral, is not uncommon. The causes are multiple and are on either an organic or a functional basis. We cannot discuss the various causes in this paper, but we can suggest that in some cases loss of motion is due to interference with the function of the nerves at their origins in the brain and spinal cord or anywhere along their course through the vagus and recurrent laryngeal nerves until the muscles in the larynx are reached. This interference may be caused by surgical or other trauma or by disease involving the nerve itself or contiguous structures. Other causes for failure of function of the vocal cords are intrinsic in the structures of the larynx or cords themselves. These causes may be trauma and disease. Full motion of the cricoarytenoid joints is a prerequisite for full range of motion of the vocal cords. Distortion, enlargement of the larynx or arthritis in these joints will limit motion of the cords. If the larynx can be viewed easily by direct suspension, it is possible to test the range of motion of the joints with a laryngeal forceps, but, unfortunately, the larynx in cases of acromegaly is not always easily viewed by direct means, since the patients have tremendous tongues and marked enlargement of the jaws, which, at times, interfere with the examination.

In the 453 cases of acromegaly from the clinic we found an abnormally high incidence of deflection of the nasal septum. Enlargement of other cartilaginous structures in the body was usually found as well. In this disease the abnormal growth does not proceed at the same rate in all bony structures or in all cartilage. Consequently, the prominent jaws, large nose, spadelike hands and large feet are common features. The same irregular growth takes place in the cartilages of the larynx and causes them to enlarge and stretch out the vocal bands. The lowered pitch of the voice is a result. It is possible that this enlargement of the larynx may interfere with and limit the motion of the cricoarytenoid joints, and as the mucous membrane becomes thicker and distortion greater, the motion of the joints eventually may be entirely obliterated.

Another possible explanation for the fixation of the vocal cord in association with acromegaly is paralysis of the recurrent laryngeal nerve. Since the lower segments of both nerves are more or less fixed as they pass around the great arteries (innominate and aortic arch), a pull from the upper (terminal) segment caused by the progressive enlargement of

the larynx may produce sufficient stretch on the nerves to impair their function. The finding of a taut left inferior laryngeal nerve in our case 1 suggests this as a possible explanation of the cause.

When fixation of the vocal cords does occur, it may be unilateral or bilateral and partial or complete. When bilateral and complete, it is a serious condition and often requires emergency treatment by tracheotomy and insertion of a cannula in the trachea. It is surprising, however, to note sometimes how well these patients are when they do not exert themselves. Further diminution of the airway from irritation or infection with development of sudden anoxia is a constant danger, however. If this occurs a fatal outcome is imminent unless the trachea can be opened quickly.

It is our observation that limitation of the airway develops gradually over the course of the disease. It usually occurs when the patient has had the disease for some time and the degree of limitation is not changed by removal of the adenoma of the pituitary body or by thyroidectomy. The patient notes that he is not able to sing and that his voice has become monotonous. Those about him complain of noisy, stertorous breathing while he is sleeping. Exertional dyspnea accompanies the onset and becomes worse as the size of the airway decreases. Many of our patients who had acromegaly complained of a marked sense of compression over the sternum. Although cardiac disease is not uncommon, examination of the heart and lungs may often fail to reveal a cause for this symptom. Whether fixation of the vocal cord is in any way responsible for the sense of compression over the sternum we are not certain, but it should be considered. In certain of our cases, however, function of the vocal cords appeared normal and the patient still complained of compression over the sternum.

The risk of surgical operation on the patient who has acromegaly is high. If this patient, in addition, has undiscovered, bilateral fixation of the vocal cords the surgical risk is much greater. It is our hope that as a result of this report greater care will be taken in the future to ascertain the function of the larynx in this group of patients who have acromegaly and especially of those who are about to undergo surgical procedures. Considerable embarrassment will be saved the surgeon who performs thyroidectomy on such a patient and discovers to his chagrin later that both vocal cords are fixed and tracheotomy is necessary. The mortality rate from operation on pituitary adenomas may be reduced if careful examination of the larynx is made and corrective measures are instituted prior to the operative procedure. It is folly to fail to make this examination, and if a physician is tempted to omit it because of the large tongue, he should be encouraged to try several times until he is certain of the motion of the vocal cords. Cocainization of the larynx may be necessary

in order to obtain an adequate view of the various structures. The degree of excursion of the cords is the important finding. Too often examination is abandoned when motion of both cords is observed and observations are not made to determine how far apart they actually move. In such cases partial fixation would be missed.

REPORT OF CASES

CASE 1.—The patient, a white woman 38 years of age, was admitted to the clinic on April 15, 1947. Her chief complaint was pain in the head and neck of two years' duration. She had observed the onset of acromegalic features seven years previously. Her hands, feet, nose, lips, jaw, brows and tongue had enlarged. The size of her shoes had changed from size 5 to size 8 during the seven years. Menstruation had ceased and severe bitemporal headaches had developed in the preceding two years. In the two weeks before admission, vision, especially vision to the sides, had failed. She had had a goiter for two years and a chronic cough and wheezing for the past year. Chronic constipation had plagued her for a number of years. She had been unable to sing for several years, and her husband commented on her noisy breathing at night.

On physical examination she weighed 140 pounds (63.5 Kg.). Her blood pressure was 148 mm. of mercury systolic and 94 diastolic; her temperature was 99.2 F. Acromegalic features and a large bilateral adenomatous goiter were noted. Bitemporal defects in the visual fields were evident, and the pupil of the left eye was constricted, as it had been all her life. Her chest, heart, lungs and reflexes were normal.

On April 19 routine preoperative examination of the larynx in the section on laryngology, oral and plastic surgery revealed that both vocal cords would move but abduction was limited to 50 per cent of normal bilaterally; as a result, the airway was only half of normal size. The goiter seemed large enough to be causing respiratory and venous obstruction. Stridor was moderate, but because of the partial fixation of the vocal cords it was decided not to remove the thyroid gland at that time, since the risk of further nerve injury would be too great. On May 11, however, a transfrontal craniotomy was done by Dr. J. G. Love, and an intracapsular mixed type of pituitary adenoma with an excess of eosinophils was removed. Extensive resection of the capsule was necessary. The patient had an uneventful convalescence and was dismissed from the hospital May 18. The visual fields showed practically complete recovery of vision on May 21.

The patient was seen again in September. At that time the laryngeal findings were the same as previously, although she thought her voice was not as husky. Breathing was becoming worse when the patient was seen in November. In January 1948 she noted increasing polydypsia, polyuria and nocturia. She was examined at regular intervals, and her respiratory difficulties appeared to be getting worse. Dyspnea on exertion or with crying was pronounced, and on January 12 examination of the vocal cords showed the usual hypertrophy of the soft tissues of the pharynx and introitus of the larynx seen in acromegaly. There was bilateral fixation of the vocal cords with a scant 2 mm. airway between them, and it was concluded that she was doing surprisingly well with an airway that small.

On Jan. 27, 1949 it was felt that thyroidectomy could no longer be deferred, since the roentgenogram revealed considerable compression and displacement of the trachea and the patient's dyspnea was increasing. That day the vocal cords were again examined and found to be in the bilateral midline position. On January 31

subtotal thyroidectomy was performed. After intubation of the trachea the patient was put to sleep with nitrous oxide, oxygen and ether. Resection of both lobes of the thyroid was done with removal of 286 Gm. of adenomatous tissue. During the course of the operation both recurrent nerves were exposed in order to determine whether there was gross evidence of compression or distortion. While the recurrent nerve on the right side seemed normal, the nerve on the left was definitely taut as though it was stretched. Before the wound was closed, the trachea was opened and a tracheal tube inserted.

The patient had an uneventful convalescence and rested much better after tracheotomy. The daily output of urine while the patient was in the hospital dropped from 5,700 to 1,200 cc. and the intake of fluid from 6,300 to 2,350 cc. Her stools also changed from small, round, hard scybalous balls to stools of normal size and consistency. Water balance righted itself remarkably after thyroidectomy. She was dismissed from the hospital on the eighteenth postoperative day.

Laryngeal examination on February 21 showed no change in the position of the cords, and it was suggested that later a King operation or an arytenoidectomy should be performed. Arytenoidectomy has recently been performed by Dr. Figi. It is too early to evaluate the results. The course following thyroidectomy has been excellent.

Laboratory observations of significance were 12.4 Gm. of hemoglobin in one hundred cubic centimeters of blood and 4,330,000 erythrocytes and 4,600 leukocytes per cubic millimeter on April 21, 1947. The serologic studies gave negative results. The sedimentation rate of erythrocytes was 20 mm. in one hour (Westergren), and the concentration of sugar in the blood was 109 mg. per hundred cubic centimeters. The value for blood cholesterol was 203 mg. per hundred cubic centimeters and the determination of the 17-ketosteroids in urine revealed 10 mg. in twenty-four hours. No significant variation from these values was seen during her course.

This case was interesting because thyroidectomy furnished the opportunity for examination of the recurrent laryngeal nerves. Also, this patient surely would have died of asphyxia if careful laryngeal examinations had not been made previously and a plan mapped out for performing tracheotomy immediately after removal of the thyroid gland.

CASE 2.—The patient, a white man aged 40, was first seen at the clinic on April 8, 1949. His chief complaints were dyspnea on exertion and the onset in the past two weeks of severe progressive laryngeal stridor. He gave a history of having had all the characteristics of advanced acromegaly for at least seven years. Roentgenograms taken four years previously had demonstrated erosion of the sella, and roentgen therapy had been given for tumor of the hypophysis. During the winter of 1948 and 1949 the patient had had considerable difficulty with bronchitis. However, it was not until two weeks prior to admission that he began to notice considerable respiratory embarrassment with exertion, which had become worse daily.

Examination on admission revealed typical enlargement of the jaw, tongue and nose and spadelike hands and large feet. His voice was deep and hoarse and showed evidence of stridor with each respiration. External examination of the neck did not reveal any thyroid enlargement or other tumors pressing on the larynx or trachea. Laryngeal examination showed some polypoid thickening of both vocal cords with bilateral fixation of the cords. The airway between them was reduced 90 per cent. Respiratory embarrassment was so great that tracheotomy was performed on April 8, 1949.

While the patient was in the hospital, laboratory studies revealed 15.4 Gm. of hemoglobin, 42 mg. of urea and 113 mg. of sugar per hundred cubic centimeters of blood. Serologic tests gave negative results. Specific gravity of the urine was 1.022. The urine also contained albumin grade 3+ (on a grading basis of 1 to 4), 8 to 20 erythrocytes and 3 to 20 pus cells per high power field and occasional casts. Roentgenograms showed evidence of enlargement of the frontal sinuses and some fibrosis in the base of the left lung with changes in the ribs consistent with acromegaly.

The patient was remarkably improved after tracheotomy. Another examination of the larynx showed that both vocal cords were fixed in close approximation in the midline position. It was felt that the patient should be sent home to become adjusted to the tracheal tube before corrective procedures were undertaken on his vocal cords.

Examination of his eyes yielded nothing of importance and his visual fields were found to be normal. Roentgen therapy to his pituitary gland was begun on April 14. He was dismissed on April 20, much improved, and was advised to return at a later date for further treatment.

This case demonstrates that the airway may be adequate within certain limitations until an infection of the upper respiratory tract sets in and precipitates the dyspnea. The absence of enlargement of the thyroid gland served to rule out compression by the thyroid as a factor in this case.

CASE 3.—A white man 31 years of age was admitted to the clinic on June 3, 1947. His chief complaint was shortness of breath. He stated that his face had been wide and his jaw prominent as long as he could remember. He had served in the army and had undergone the strenuous basic training without difficulty. Those who lived with him, however, complained that he made a great deal of noise while sleeping. Ten months prior to being seen at the clinic he had noticed the onset of hoarseness and dyspnea on exertion, which had been progressive since that time. He had consulted his physician in regard to his dyspnea; the physician was unable to pass a bronchoscope and informed the patient that the vocal cords were fixed bilaterally, with about 20 per cent of the normal airway remaining. The patient also gave a history of headaches for many years and tinnitus in both ears for more than ten years.

Physical examination on admission revealed the typical features of acromegaly, including the acromegalic facies and spadelike hands. Visual fields were normal and the remainder of the examination disclosed essentially normal conditions except in the larynx. Both vocal cords were fixed bilaterally and only about 20 per cent of the normal airway remained. There was a small nodule in the midportion of the left vocal cord. The arytenoids were thickened and the tongue was large.

Laboratory examinations revealed an unexplained hypochromic anemia with 7.9 Gm. of hemoglobin per hundred cubic centimeters of blood and 3,840,000 erythrocytes. Serologic tests and roentgenograms of the chest revealed essentially normal conditions, but a roentgenogram of the skull showed calcification of the falx and enlargement of the sella by an intrasellar tumor. Examination of the urine for 17-ketosteroids revealed 22.1 mg. in twenty-four hours. Gastric analysis revealed a normal quantity of acids. Neurologic examination gave negative results. No cause was found for the anemia, and roentgenographic studies of the stomach, small bowel and colon were noncontributory.

The patient was able to get along fairly well with the limited airway as long as he did not exert himself too much. His condition was explained to him and he chose to go home and restrict his activities rather than have anything done at this time. He was dismissed and has not returned to the clinic.

The fact that the patient's physician could not pass a bronchoscope through the narrowed airway suggests that the cricoarytenoid joints may have been somewhat unyielding. The rubber endotracheal tube passed in case 1 may have passed because it was softer and more flexible than a bronchoscope. The normal gastric acids in case 3 also suggest that vagus function probably was intact but cannot be interpreted as indisputable evidence of this.

Case 4.—A 56 year old white man was first seen at the clinic on Oct. 9, 1939. His chief complaints were palpitation and drowsiness of about five years' duration. He stated that he had had retrosternal pain for many years which was aggravated by exercise and was becoming increasingly more intense. He found it necessary to use two pillows at night when sleeping. Approximately four years prior to admission he had noted increasing drowsiness and was unable to read a newspaper without falling asleep. He had known that he had acromegaly for twenty years. In recent years he had had attacks of dizziness and occasional headaches but no visual disturbances. He informed us that three years prior to admission his voice had become harsh and rasping and that for the preceding six months he had noted increasing dyspnea on exertion. He had had two series of roentgen treatments for pituitary tumor in 1935 and 1936 without apparent retardation of symptoms. In January 1939 he was admitted to a hospital elsewhere and thyroidectomy was done because of increased nervousness, tremor and palpitation. His surgeon wrote us that both recurrent laryngeal nerves could be seen clearly and were not disturbed. The pathologist reported that the tissue removed contained macrofollicular and microfollicular colloid adenoma with cystic changes. The day following the operation laryngeal obstruction developed, and emergency tracheotomy was performed. Examination of the vocal cords then revealed bilateral complete abductor paralysis. The patient's condition had gradually improved and his doctors had thought they noted improvement in the motion of the vocal cords and allowed the tracheal stoma to close. The patient, however, still felt some dyspnea on exertion.

On physical examination on admission to the clinic, the patient was found to be 5 feet 4 inches tall (162.6 cm.) and weighed 142 pounds (64.4 Kg.). His blood pressure was 176 mm. of mercury systolic and 80 mm. diastolic, the pulse rate was 74 beats per minute and the temperature was 96 F. A stertorous tachypnea was noted. There was still some purulent drainage from the thyroidectomy and tracheotomy wounds. There were noisy breath sounds in his chest. His heart was not enlarged. Laryngeal examination revealed that the vocal cords were fixed very close to the midline position bilaterally. There was, in addition, some polypoid thickening of both vocal cords which almost completely obliterated the small remaining airway. The remainder of his examination was essentially noncontributory except for his prominent jaw, large nose, spadelike hands and enlarged feet. His visual fields were also normal.

Laboratory studies showed the urine and blood to be normal. Results of serologic tests were negative for syphilis. Sugar tolerance was decreased somewhat, and the basal metabolic rate was +28 per cent.

Because the airway was inadequate another opening was made in the trachea on Oct. 13, 1939. The purulent drainage was apparently due to a silk suture used in previous operation. Laryngeal examination on October 23 revealed that the left cord still was fixed in a midline position, but motion of the right cord had improved so that 30 to 40 per cent of the normal airway was available for breathing. The patient continued to improve and was dismissed from our care on October 30. He planned to return later for consideration of corrective procedures on his vocal cords but did not return. He was last heard from in 1943, at which time he was still using a tracheal tube and getting along well.

Thyroidectomy was performed on this patient before fixation of the vocal cords was noted, and, naturally, this procedure cannot be ruled out as a possible cause of the fixation. The fact that the surgeon saw the nerves clearly cannot be entirely dismissed, however, and if this case is considered in the light of the others mentioned there is probably not much doubt that the condition of the vocal cords was due to the acromegaly and not to operative trauma.

CASE 5.—A man aged 63 was admitted to the clinic on Nov. 3, 1938. He had known that he had acromegaly for twenty years. His voice had been coarse and deep for many years. Five months before admission he first had noted dizziness and weakness with some numbness in the right arm and leg. He also mentioned going to sleep while talking, playing cards or driving his car. One month before admission he had noted dyspnea on mild exertion, and this was his chief complaint. He had had a cold for that entire month but it seemed to be improving.

On physical examination were noted prognathism, thickened lips and tongue, a large nose, coarse voice, spadelike hands, enlarged feet, hypertrophic thickening of the mucous membrane in the nose, bilateral inguinal and femoral hernias and moderate rectal prolapse. The thyroid was not enlarged. Blood pressure was 170 mm. systolic and 106 diastolic. Visual fields were found to be normal. The remainder of his physical examination was noncontributory.

The larynx was examined on November 8. The right cord was fixed in the midline position and the left cord had only about 25 per cent of its normal abductor motion. The airway between the cords was reduced to a scant 2 mm. opening. Considerable mucus in each piriform fossa was thought to be the explanation for the patient's dyspnea. Neurologic examination revealed decreased reflexes in the region of the soft palate and decreased sensation on the forehead and face. It was concluded that the patient had residual signs of, possibly, a cerebrovascular accident.

The concentration of hemoglobin was 13.1 Gm. per hundred cubic centimeters. Results of other tests on the blood were within normal limits, and serologic tests were negative for syphilis. The urine contained albumin, grade 2+, occasional erythrocytes, pus cells and a few casts. Roentgenograms of the head revealed an enlarged sella with erosion of the floor of the sella and under surface of each anterior clinoid process. Calcification of each internal carotid artery was marked, as were acromegalic changes in the calvarium and sinuses. The basal metabolic rate was +32 per cent and the electrocardiogram showed considerable evidence of damage to the heart. It was felt that the patient could get along with restricted activity and symptomatic treatment, and, therefore, no operation was advised in view of the increased risk. The patient was dismissed and did not return to the clinic.

The findings in this case are clouded somewhat by the history of a cerebrovascular accident. In spite of this, it is probably safe to conclude that the acromegaly was the cause of the laryngeal abnormalities, for the mucous membrane of the larynx showed the typical changes.

Case 6.—A man 51 years old was admitted to the clinic on Oct. 15, 1921. He had known that he had acromegaly for many years. His chief complaints were sore throat of ten months' duration and rheumatism in the knee for more than a year. In January 1921, a severe cold had developed. One month later hoarseness developed and had persisted to the time of admission. For one month he had noted dyspnea on exertion and obstruction to breathing, especially at night.

On examination at the clinic the patient's blood pressure was 182 mm. systolic and 115 diastolic. The face and extremities showed pronounced acromegalic changes. Generalized hirsutism and some enlargement of the cervical lymph nodes also were present. The thyroid gland was normal in size. Visual fields were normal and the remainder of the general examination was essentially noncontributory.

The laboratory findings of interest were a value for hemoglobin of 77 per cent, a strongly positive Wassermann reaction on the blood and negative reactions on examination of the spinal fluid. The basal metabolic rate was +33 per cent. A roentgenogram of the skull revealed decided enlargement of the sella with erosion of the clinoid processes.

Because indirect laryngoscopy was difficult, suspension direct laryngoscopy was used. Edema of the epiglottis and arytenoid cartilages was noted. Both cords were somewhat reddened. The left cord was found to be fixed in the position indicative of complete abductor paralysis. The right vocal cord moved normally. The findings were explained to the patient, and he went home planning to reduce activity. The thyroid disease was not severe enough to warrant operation and the risk of paralysis of the good cord. The patient was seen again in 1926, by which time pronounced polydypsia, polyuria and vertigo had developed. The basal metabolic rate had fallen to +5 per cent. He was not complaining of his respiratory difficulties at that time. The patient died April 29, 1937, with arteriosclerotic gangrene of the feet.

The positive serologic findings in this case are unique for the group of cases reported herein. The lack of contributory findings in the spinal fluid probably rules out a central causative factor. The unilateral fixation is also unique, and we can suggest only that the acromegaly was the cause, but we have no other similar case to lend it support. Lediard [5] reported a case of acromegaly in which the patient had unilateral abductor paralysis of a vocal cord associated with thyroidectomy, but the larynx had not been examined prior to surgical procedure.

Case 7.—A woman aged 36, who was seen at the clinic on June 12, 1925, gave as her chief complaints dyspnea and dysphagia of one year's duration. She had first been seen at the clinic in 1918 when she was 29 years old; at that time diagnosis of acromegaly was made. Her condition had not changed much in the next six years, although many of her previous complaints had subsided. About a year prior to the admission in 1925 she had noted increasing palpitation, tachy-

5. Lediard, H. A.: Acromegaly and Operation for Goitre, Tr. Clin. Soc. London **36**:190 (March 27) 1903.

cardia, edema of her legs and ankles and some increase in nervousness. For three months before admission she had had frequent frontal headaches with occasional dizzy spells. Her thyroid gland had enlarged noticeably, and when she bent forward she felt a sensation of strangulation. At times she was awakened at night by the same sensation.

On physical examination were observed typical acromegalic features, some exophthalmos, mild edema of both legs and ankles and slight loss of strength. Blood pressure was 175 mm. systolic and 102 diastolic. The thyroid gland was enlarged and nodular, and a harsh systolic murmur was heard over the entire precordium. Laryngeal examination revealed torsion of the larynx to the left, with some limitation of abduction of both vocal cords; however, some movement was present. The amount of this limitation is not known. In addition, deflection of the nasal septum, with partial obstruction of the nasal airway, was found. Visual fields were normal.

Laboratory findings of note were a value for hemoglobin of 55 per cent and 3,280,000 erythrocytes. Her serologic tests gave negative results. The basal metabolic rate was +37 per cent on June 15 and +28 per cent on June 17. Roentgenologic examination revealed considerable enlargement of the sella, with erosion of the posterior clinoid processes.

Thyroidectomy was performed on June 20. The postoperative course was uneventful, and in spite of limitation of motion of the vocal cords no difficulty occurred. Postoperative examination of the vocal cords disclosed no change.

This case is interesting because only partial fixation of the vocal cords was present. Furthermore, the fixation had progressed equally in each cord, as it did in the cords in case 1, in which observations were made for a longer period.

SUMMARY

Seven cases of acromegaly have been presented. In 5 of these nearly complete bilateral fixation of the vocal cords had occurred; in 1 case there was partial bilateral fixation of the cords, and in 1 case one cord was fixed in the position of complete abductor paralysis. The etiologic factor is not certain. Paralysis of the recurrent laryngeal nerve through stretching by overgrowth of the cartilaginous structures is a possibility. Interference with the movement of the cricoarytenoid joint is also a possibility. Tissue overgrowth or cartilage enlargement might serve to limit the motion of the joint.

The vocal cords of all patients who have acromegaly should be examined before operation, as should those of any of these patients whose presenting symptom is dyspnea or hoarseness.

FENESTRATION BY COLD FRACTURE METHOD

Preliminary Report of an Improved Technic

SAMUEL ROSEN, M.D.
NEW YORK

SHAMBAUGH and Juers [1] in 1946 were the first to evaluate properly the role of bone dust in bony closure of the fenestra. They therefore modified the Lempert operation with new technics designed to prevent osteogenetic closure of the fenestra and the subsequent poor result. These modifications were based on experimental and histologic studies in monkeys, which demonstrated that whenever bone dust or bone particles found their way into the perilymph space osteogenetic closure of the fenestra resulted. To keep the fenestra free of bone dust, they developed the technic of continuous irrigation and soon were able to report a marked decrease in the incidence of bony fenestral closure. This use of continuous irrigation has gained wide acceptance.

About two years after Shambaugh and Juers made their improvement on the fenestration operation, Lempert [2] also noted that bone dust and bone splinters created by the action of the electrically driven burr disappeared into the perilymph space. This secretion of bone dust and splinters stimulated new bone formation, caused the subsequent closure of the fenestra and resulted inevitably in poor hearing. Lempert made histologic studies on fenestration in monkeys and came to the same conclusion as Shambaugh and Juers. He observed also in a large number of revision operations performed on patients that bone dust in the perilymph space was responsible for the fenestral closures in these cases.

Recently Lempert [2] described a new technic for creating a fenestra which is free from bone dust. This technic consists in wearing down the bone until the final area of the fenestra has become grayish blue in

From the Otolaryngological Service, The Mount Sinai Hospital.

Read before the New York Academy of Medicine, Section of Otolaryngology, Jan. 18, 1950.

1. Shambaugh, G. E., and Juers, A. L.: Surgical Treatment of Otosclerosis, Arch. Otolaryng. **43**:549-567 (June) 1946.

2. Lempert, J.: Bone-Dust-Free Lempert Fenestra Nov-Ovalis: New Revolutionary Development of Surgical Treatment of Clinical Otosclerosis, Arch. Otolaryng. **47**:280-288 (March) 1948.

transparency. At frequent intervals, the bone dust is removed by irrigation and suction. Then the entire circumference of this intact bony endosteal cupola is cut with a sharp knife, the point of which enters the perilymph space. The cupola, or roof of the fenestra, is then lifted away, exposing the perilymph space and membranous labyrinth. The claim is made that this technic completely prevents any bone dust or any bone particles from reaching the perilymph space.

I have used the cupola technic of Lempert on 50 consecutive fresh adult cadavers and made the following observations.

1. In 18 cases the cupola came away intact. In the remaining 32 cases, however, the cupola cracked in many places and had to be picked away piece by piece to complete the fenestra. Certainly, this added manipulation would tend to stimulate osteogenesis rather than to minimize it.

2. In 10 of the 18 cases in which the cupola came away intact there was still present some detritus in the perilymph space, carried in presumably by the knife.

3. In 2 cases the membranous labyrinth came away with the cupola during the process of removal.

In view of these observations, it would seem that continuous irrigation is an easier, safer and more effective method of dealing with bone dust and bone particles than the cupola technic of Lempert.

During the past two years I have created the fenestra on 100 fresh cadavers, using hand-drawn dental hoe excavators instead of the electrically driven burr. Recently this technic has been successfully employed in the operating room. The effect of excessive heat as produced by the burr on the bone and the underlying membranous labyrinth is still unknown. The temperature at the site of contact of the burr may rise 25 degrees. Who has not felt the pain and the accompanying excessive heat which are generated by a dental burr revolving in a tooth cavity? It seemed natural, therefore, to try other means of fenestration, in which the heat and mechanical factors of the burr would be eliminated. The technic described in the following paragraphs might well be called "cold" fenestration, in contrast to the standard "hot" burr technic.

TECHNIC

The entire horizontal semicircular canal is freed of periosteum with a wide (2 mm.) dental hoe excavator. Then a narrow hoe excavator begins the incision 0.75 to 1 mm. from the facial canal anteriorly and superiorly, proceeding downward and posteriorly for about 4 to 6 mm. until the lower end of this incision is about 2 mm. from the facial canal. The cutting edge of the excavator is about 0.5 mm., and as it scrapes the bone from above downward repeatedly the bluish gray line gradually appears along the length of this created trough. The pressure of the instrument against the bone is then markedly reduced until the perilymph space is

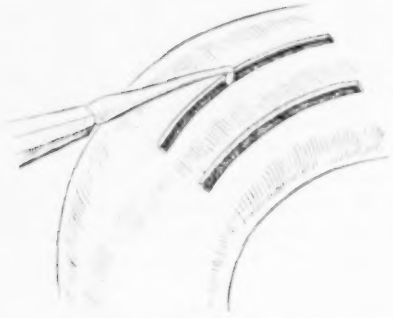


Fig. 1.—Exposure of perilymph space with hoe excavator over surgical dome of vestibule.

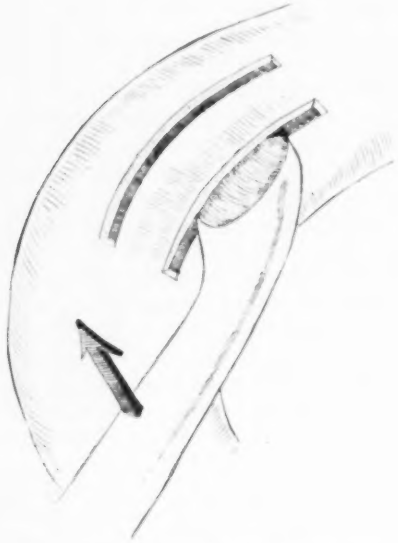


Fig. 2.—Uncapping roof of fenestra with curet.

exposed. A second parallel incision, trough and exposure of the perilymph space is created about 2 to 3 mm. posteriorly, thus demarcating the limits of the long axis of the fenestra (fig. 1). The bone between the upper and lower ends of the above incisions is left intact. Much of the external semicircular canal just behind the posterior fenestral incision is then curetted away from above downward, thus leaving the fenestra high on the summit of a mound. Then a no. 5 zero curet is introduced lengthwise into the long axis of the cupola (anteriorly on the right side and posteriorly on the left), and the cupola is snapped off with much the same motion as is used in curetting the roof of a pneumatic mastoid cell (fig. 2). This creates a very wide fenestra (fig. 3).

Fig. 3.—Wide fenestra completed; perilymph space and membranous labyrinth exposed.

In this technic no heat is generated. The fractured cupola usually comes away intact because of its natural thickness. It may well be that this method of "cold" fracture of the bony labyrinth will be least likely to favor osteogenesis. It is known, for example, that fractures of the bony labyrinth do not heal by osteogenesis. This technic obviates the hazard of mechanical disorder of the drill; in fact, the entire operation can be done very well without use of the burr. It is best first to perfect this technic on the cadaver.

101 East Seventy-Third Street (21).

SURGICAL AND ALLIED DISEASES OF THE SALIVARY GLANDS AND DUCTS

WILLIAM G. ABEL III, M.D.
NEW YORK

WHEN a patient presents himself to his physician with swelling or tenderness of one or another of the salivary glands, too often he is treated symptomatically with no attempt to establish the underlying cause. With this consideration in mind, this paper was written with the dual purpose of stimulating interest in the subject and providing a more complete classification of disorders peculiar to the salivary glands. In table 1 is outlined a proposed classification of these disorders.

Reference to the salivary glands should include not only the parotid, submaxillary and sublingual glands but also the accessory salivary glands of the mucosal surface, viz., buccal, labial, incisive, palatine and lingual. The major salivary glands secrete intermittently and do so when nerve impulses reach them, whereas the accessory salivary glands secrete almost continuously.

A. CONGENITAL ABNORMALITIES

The epithelium of the salivary glands arises as outpouchings from that part of the mouth which develops from the oral pit and, accordingly, is ectodermal. The sublingual gland arises from several epithelial buds instead of from one, as do the other salivary glands, and this form of development accounts for its several ducts.[1] Among the congenital abnormalities reported are ectopic glands,[2] absence of glands,[3] atresia

From the Surgical Service, St. Vincent's Hospital.

1. Doods, G. S.: Essentials of Human Embryology, ed. 2, New York, John Wiley & Sons, Inc., 1938. Orban, B.: Oral Histology and Embryology, St. Louis, C. V. Mosby Company, 1949.

2. Tillotson, R. S.: Aberrant Salivary Tissue in the Tonsillar Fossa, California & West. Med. **33**:744, 1930.

3. Ramsey, W. R.: A Case of Congenital Hereditary Absence of the Salivary Glands, Am. J. Dis. Child. **28**:440 (Oct.) 1924.

of ducts,[4] variability of location of duct orifices,[5] multiple ducts and congenital salivary fistulas.[6]

In persons with a total absence of the salivary glands there is a high incidence of dental caries.[7] There is some evidence that an antibacterial factor is present in normal saliva which is inhibitive to some degree against aciduric bacteria and thus helps to prevent dental caries.[8] Cheyme demonstrated a high frequency of dental caries in rats that had no salivary glands.

TABLE 1.—*Classification of Salivary Gland Disorders*

A.	Congenital abnormalities
B.	Mikulicz' disease and syndrome
C.	Uveoparotid fever
D.	Sialolithiasis and sialodolithiasis
E.	Sialadenitis
	1. Acute epidemic
	2. Acute nonepidemic
	3. Chronic nonepidemic
	4. Allergic
F.	Sialodochitis
G.	Tumors
	1. Congenital
	2. Benign
	3. Malignant
	4. Mixed
	5. Metastatic
	6. Cystic
H.	Functional disorders
	1. Ptyalism
	2. Xerostomia
	3. Central nervous system disease
I.	Trauma
	1. Injury to peripheral nerves or ducts

4. Blackmar, F. B.: A Case of Atresia of Salivary Ducts, Am. J. Ophth. **8**:139, 1925.

5. Carmody, T. E.: Pathologic Conditions Affecting the Salivary Glands and Floor of the Mouth, Surg., Gynec. & Obst. **64**:517, 1937.

6. Anthony, D. H.: Affections of the Salivary Glands and Ducts: J. Tennessee M. A. **24**:175, 1931.

7. (*a*) Steggerda, F. R.: Water Intake in Man with Dysfunctioning Salivary Glands, Am. J. Physiol. **132**:517, 1941. (*b*) Losch, P. K., and Weisberger, D.: High Caries Susceptibility in Diminished Salivation, Am. J. Orthodontics **26**:1102, 1940. (*c*) Ramsey.[3]

8. Hill, T. J.: Salivary Factor Which Influences Growth of L. Acidophilus and Is an Expression of Susceptibility or Resistance to Dental Caries, J. Am. Dent. A. **26**:239, 1939.

The role of the salivary glands in the maintenance of water and salt metabolism will not be discussed here[9]; suffice it to say that a person without salivary glands may have normal water and salt metabolism[7a] and that polydipsia is invariably present. There are no known reported cases of atresia of the ducts without concomitant atresia of the respective glands. Variability of location of duct orifices is of no significance, and congenital salivary fistula will be discussed later.

B. MIKULICZ' DISEASE AND SYNDROME

Although clinicians have been aware of Mikulicz' disease since 1892, little has been added to Mikulicz' original presentation. Essentially, it is characterized by a chronic, afebrile, nonpainful, nontender, symmetric enlargement of the salivary and lacrimal glands.[10] The swelling is smooth, firm and nonadherent to surrounding tissues.[11] There are no significant changes in the cellular component of the blood. Microscopically, there is a diffuse replacement of the gland by small round cells. These cells represent either invasion by lymphocytes or multiplication of lymphoid tissue, which normally is present in the gland.[12]

Although the cause of this bizarre condition remains obscure, it is reported[13] that radiation therapy usually causes regression of the glands to normal. Mikulicz' syndrome, however, may give a similar clinical picture, but it is due entirely to a local manifestation of a systemic disease.

C. UVEOPAROTID FEVER

Uveoparotid fever is a rare clinical syndrome occurring most commonly in the second and third decades of life; it is characterized by low grade fever, bilateral iridocyclitis, bilateral parotitis and, frequently, facial paralysis.[14] This syndrome was first described by Heerfordt in 1909 and is sometimes referred to as Heerfordt's disease. The cause

9. Best, C. H., and Taylor, N. B.: The Physiological Basis of Medical Practice: A University of Toronto Text in Applied Physiology, ed. 3, Baltimore, Williams & Wilkins Company, 1943.

10. (*a*) Reed, A. C., and Rochex, F.: Mikulicz's Disease: Case, California & West. Med. **50**:202, 1939. (*b*) Rowe, S. M.: Mikulicz's Syndrome, New England J. Med. **202**:863, 1930.

11. Beck, A. L.: Inflammation of the Salivary Glands, Surg., Gynec. & Obst. **74**:604, 1942.

12. Leucutia, T., and Price, A. E.: Mikulicz's Disease and the Mikulicz Syndrome, Am. J. Roentgenol. **24**:491, 1930.

13. Reed,[10a] Leucutia,[12] Beck.[11]

14. (*a*) Boyd, W.: A Text Book of Pathology, ed. 4, Philadelphia, Lea & Febiger, 1943. (*b*) Anderson, W. A. D.: Pathology, St. Louis, C. V. Mosby Company, 1948. (*c*) Kirby, W. M. M., and Armstrong, C. D.: Sarcoidosis with Uveoparotid Fever, Ann. Int. Med. **21**:475, 1944. (*d*) Beck.[11]

remained obscure until 1936, when Bruins Slot first suggested that it was another manifestation of sarcoidosis.[16c] Subsequent reports lend further credence to this theory.[15] Treatment for this condition is essentially symptomatic.

D. SIALOLITHIASIS AND SIALODOLITHIASIS

Numerous theories have been advanced in an attempt to explain the origin of salivary calculi. Söderlund's and Naeslund's theory [16] appears to be the most significant on the subject to date. Following is a review of the more popular theories.

1. The association of actinomycotic infection with salivary calculus formation was first demonstrated by Söderlund [16a] in 1919. Since that time he has reported more than 40 cases in which his examination of the calculi revealed the presence of actinomycetes in all. Ivy and Curtis [17] stated that Söderlund and Naeslund

> believe the cause in some cases to be the saprophytic actinomycetes inhabiting the buccal cavity, while in others that organisms are introduced from outside the body. These writers hold that colonies of the organisms in the ducts cause a decomposition in the protein of the saliva bringing about a precipitation of calcium salts by reason of a change in the p_H. The lime salts are deposited around the colonies of the organisms.

Naeslund stated the opinion that other bacteria are also capable of causing precipitation of lime salts from saliva in the same way. In experiments, Naeslund was able to cause formation of calculi from cultures of actinomycetes which he obtained from natural salivary calculi.[18]

2. Kuttner and associates [19] asserted that as a result of an inflammatory process in the gland itself its epithelium is destroyed under the influence of salivary digestion and that the debris accumulates in lumps, thereby furnishing a nucleus for calculus formation. This theory is not tenable owing to the frequency of inflammation of the parotid gland and the infrequency of stone formation in this area.

---

15. Longcope, W. T., and Pierson, J. W.: Boecks Sarcoid (Sarcoidosis), Bull. Johns Hopkins Hosp. **60**:223, 1937. Anderson.[16b]

16. (*a*) Söderlund, G.: Einige neue Beiträge zur Kasuistik der primären Speicheldrüsenaktinomycose, Acta. chir. Scandinav. **53**:189, 1920. (*b*) Naeslund, C.: Fortgesetzte Untersuchungen über die Speichelsteinbildung unter besonderer Berücksichtigung ihres Verhältnisses zur Entstehung primärer Speicheldrüsenaktinomykose, Acta. path. et microbiol. Scandinav. **6**:78, 1929.

17. Ivy, R. H., and Curtis, L.: Salivary Calculi, Ann. Surg. **96**:979, 1932.

18. Ivy and Curtis.[17] Naeslund.[16b]

19. Kuttner, Hanzel and Kroiss, cited by Tholen, E.: Calculus of the Salivary Glands, Arch. Otolaryng. **35**:761, 1942.

3. Many isolated cases[20] are reported in the literature which stress a foreign body as a nidus for calculus formation. A foreign body may be the source of such formation in a few cases, but it certainly is an unimportant and accidental causative agent.

4. Kirk[21] made the following statement:

> As the saliva contains carbon dioxide in solution, it has been assumed that the escape of the carbon dioxide in the mouth, which was the solvent of the calcium carbonate and tricalcicphosphate, causes a precipitation of those salts in the presence of the colloid mucin, resulting in time in a calcic concretion modified in its physical characteristics by the conditions under which the precipitate and concretion occurred.

Calculi are found more frequently in the submaxillary gland and duct. Statistically, they occur in this region from 10 to 20 times oftener than in the parotid gland and duct[22] (table 2). This peculiar predilection as to site probably is due to a combination of several factors: (*a*) Wharton's duct is the longest of all the ducts; (*b*) the major part of the

TABLE 2.—*Percentage Incidence of Calculi According to the Gland or Duct Involved*

Author	Submaxillary	Parotid	Sublingual
New, G. B., and Harper, F. R.: Surg., Gynec. & Obst. **53**:456, 1931	92.9	4.3	2.8
Abel	100	0.0	0.0
Hoover[16]	100	0.0	0.0
Greenfield, S. D.: Laryngoscope **52**:629, 1942	90.3	3.2	6.4
Ivy and Curtis[17]	90.4	9.5	0.0

gland is lower than its duct (this position would tend to retard the rate of flow of saliva), and (*c*) its secretion has a higher viscosity and higher protein content than that of the other glands.[23]

20. (*a*) Carmody, T. E.: Pathologic Conditions Affecting Salivary Glands and Floor of the Mouth, Surg., Gynec. & Obst. **64**:517, 1937. (*b*) Berger, A.: Principles and Technique of Oral Surgery, Brooklyn, N. Y., Dental Items of Interest Publishing Co., Inc., 1923. (*c*) Blady, J. V., and Hocker, A. F.: Sialography: Its Technique and Application in Roentgen Study of Neoplasms of Parotid Gland, Surg., Gynec. & Obst. **67**:779, 1938. (*d*) Anthony.[6] (*e*) Ivy and Curtis.[17]

21. Kirk, quoted by Prinz, H.: The Origin of Salivary Calculus: Review of Older Theories, Dent. Cosmos. **63**:231, 1921.

22. (*a*) Neuhof, H.: Sialolithiasis and Sialodochitis in Childhood, Am. J. Dis. Child. **11**:232 (March) 1916. (*b*) New, G. W., and Harper, F. R.: Chronic Inflammation of Salivary Glands With or Without Calculi, Surg., Gynec. & Obst. **53**:456, 1931. (*c*) Patterson, R. H.: Salivary Gland and Duct Calculi, Surg. Clin. North America **12**:335, 1932. (*d*) Ivy and Curtis.[17] (*e*) Kuttner, Hanzel and Kroiss.[19]

23. Wolf, G. D., and Soloway, D.: Sialadenitis; Diagnosis and Management, J. Am. Dent. A. **31**:1030, 1944. Best and Taylor.[9]

Chemical analysis of the calculi usually will reveal a predominance of calcium carbonate and calcium phosphate.[24] There appears to be no seasonal influence on the rate of flow or on the calcium or phosphorus content of resting saliva.[25] There is no significant predominating sex incidence, although calculi appear to be commoner in males.[26] Calculi have been reported to occur in the first eight decades of life, occurring most frequently in the third and fourth.

The symptoms caused by gland calculi are invariably far less severe than those of duct calculi. The patient is usually made cognizant of his difficulty by intermittent attacks of pain in the affected area. The subsequent appearance of a sensitive salivary swelling which is tense and firm is usually the rule. Suppuration may then occur with a mucopurulent discharge which drains from the duct orifice. The duct ostium becomes reddened and edematous. This condition may be further complicated by periductal or periglandular abscesses, fistulas or cellulitis.[27]

Calculi located near a duct orifice are easily palpable through the buccal mucosa, but in other instances, especially when the stone resides within the gland, palpation is difficult if not impossible. The history in most instances is fairly characteristic, and when it is coupled with a palpable stone it is conclusive. The diagnosis of a gland stone, however, is based chiefly on the history and appropriate roentgenologic examination, which should include an intraoral occlusal view and a lateral extraoral view.[28]

Treatment is dictated, of necessity, by the site of the calculus. Stones located near the duct orifices may, if not too large, be stimulated to pass spontaneously by dilation of the duct with bougies. If this procedure does not suffice (and for those calculi located nearer the gland) operative intervention is indicated, through the intraoral route when possible. With local anesthesia a small incision is made in the mucosa over the stone along the axis of the duct. The duct is then opened longitudinally and the stone removed. The defect in the duct and mucosa is

24. Glock, G. E., and Murray, M. M.: Chemical Investigation of Salivary Calculus, J. Dent. Research **17**:257, 1938. Wakely, C. P. G.: Formation and Treatment of Salivary Calculi, Lancet **1**:708, 1929. Kirk.[21]

25. Wainwright, W. W., and Becks, H.: Human Saliva: Is There Seasonal Influence on Rate of Flow and Calcium and Phosphorus Content of Resting Saliva? J. Dent. Research **25**:285, 1946.

26. Carter, W. W.: Salivary Calculus: Report of A Case, Laryngoscope **27**:881, 1907. Ivy and Curtis.[17] Kuttner, Hanzel and Kroiss.[19]

27. (*a*) Childrey, J. H.: Phlegmon and Fistula from Calculus of Salivary Gland, Arch. Otolaryng. **27**:204 (Feb.) 1938. (*b*) Unpublished data of the author.

28. Field, H. J., and Ackerman, A. A.: Salivary Calculi: Technique for Removal, J. Am. Dent. A. **30**:115, 1943.

repaired with plain interrupted surgical sutures if no inflammation is present; otherwise it is packed open with a wick of petrolatum gauze.[29]

For gland stones (except sublingual) the initial episode should be treated conservatively with hot fomentations, strict oral hygiene and antibiotics. After subsidence of the acute phase the stone should be removed, if possible; otherwise excision of the gland is indicated. The removal of the gland does not preclude the formation of future stones in its duct.[27b] When this condition occurs it should be treated as described above.

E. SIALADENITIS

Acute epidemic sialadenitis refers specifically to mumps and will not be discussed here. Nonepidemic sialadenitis may be acute or chronic, suppurative or nonsuppurative, and the causes may be classified as local or general. Among the local causes are poor oral hygiene, disease of the oral mucosa, trauma to the gland, calculi, foreign bodies and inflammatory processes in adjacent structures. Some of the general causes are any acute infectious disease; postoperative condition; the continued use of drugs or heavy metals; part of the picture complex in terminal illnesses; syphilis[11]; tuberculosis,[30] and actinomycosis.[6]

Three possible routes for infection to reach the salivary glands were described by Marley,[31] viz., hematogenous, lymphatic and ascending by way of the ducts. There is a paucity of evidence to support the hematogenous view. Berndt and associates injected cultures of pyogenic organisms into the internal maxillary arteries of dogs and produced only a mild inflammatory response in three out of 15. When the bacteria were injected directly into the duct, however, in seven of 10 dogs a suppurative parotitis developed, and in three there was a mild inflammatory reaction.

The parotid gland is involved far more frequently than the other glands,[32] and if the infection were blood borne such rate of involvement could not be explained. There is an intimate anatomic juxtaposition of the major salivary glands with the reticuloendothelial system. An aggregation of lymphatic tissue is found on both the capsule and within the substance of the parotid gland,[11] and lymph nodes lie on the capsule of the submaxillary gland. It is obvious, therefore, that enlargement of the lymph nodes at the site of the salivary glands may lead to con-

29. Havens, F. Z.: Removal of Calculi from the Submaxillary Ducts, Surg. Clin. North America **15**:1227, 1935.

30. Carmody, T. E.: Tuberculosis of the Parotid Gland, Laryngoscope **24**:873, 1914.

31. Talbot, H. S.: Acute Suppurative Parotitis, Am. J. Surg. **25**:267, 1934.

32. (*a*) Morris, S. A.: Pathologic Conditions Affecting Salivary Glands, California & West. Med. **57**:190, 1942. (*b*) Swinburne, G.: Sialoangiectasis, Brit. J. Surg. **27**:713, 1940. (*c*) Altemeier, W. A.: Acute Secondary Parotitis, Surgery **20**:191, 1946. (*d*) Carmody,[30] (*e*) Beck.[11]

fusion in diagnosis. It is also possible for the salivary glands to be involved secondarily from an infection of the adjacent lymph nodes or from an infective focus within the lymphatic radius of the glands. Obvious lymphatic lesions are absent in most cases, and, therefore, this route of infection is not the principal one.

Ascending infection along the respective ducts remains as a possible route by exclusion. Normally, the buccal cavity is inhabited by a varied flora, but the offending organism in more than 90 per cent of the cases of suppurative sialadenitis is the Staphylococcus.[33] Seifert[34] demonstrated a bacteriostatic effect of mucin on the growth of Staphylococcus, which was approximately proportional to the mucin content of the culture media. Seifert was also able to show that the Staphylococcus is irregularly distributed in the mouth, with the highest concentration in the region of the molar teeth (adjacent to the orifice of Stenson's duct) and a less common occurrence in the mucin-rich sublingual area.[35]

Seifert took cultures from the buccal cavities of persons before and after operations and found that the Staphylococcus count was low preoperatively and rose enormously postoperatively.[35] He was able to prevent this rise by preventing drying of the mucous membranes.[35]

Surgical parotitis has now become less common since the realization of the importance of oral hygiene and fluid balance. Mourer,[36] in 1937, found only 30 cases of this condition in 35,000 operations. Rankin and Palmer[37] estimated the incidence of surgical parotitis between 0.04 and 0.7 per cent, and Altemeier[38] stated the belief that the average was less than 0.5 per cent. The mortality rate from surgical parotitis is variously reported as being from 30 to 60 per cent and is due principally to the propensity of the condition to occur after major surgical procedures, in severe toxemia and in patients debilitated by prolonged illnesses.

Sialadenitis may occur at any age, though nonepidemic sialadenitis occurs most commonly in the third decade of life. Baxter and MacDonald[39] reported a case of suppurative parotitis in a 7 day old infant following a difficult delivery. In 19,000 full term infants delivered in

33. Altemier.[32c] Talbot.[31]

34. Seifert, E.: Ueber den Infectionsweg bei postoperativer Parotitis: Der Einfluss des Muzins auf Staphylococcen, Deutsche Ztschr. f. Chir. **222**:345, 1930.

35. Seifert, E.: Ueber den Infektionsweg bei postoperativer Parotitis, Deutsche Ztschr. f. Chir. **198**:387, 1926.

36. Wiesen, A. M.: Surgical Parotitis, J. Iowa M. Soc. **28**:94, 1938.

37. Rankin, F. W., and Palmer, B. M.: Post-Operative Parotiditis Treated With and Without Radium, Ann. Surg. **92**:1007, 1930.

38. Altemeier, W. A.: Post-Operative Infections, Surg. Clin. North America **25**:1202, 1945.

39. Baxter, R. H., and MacDonald, M. T.: Acute Suppurative Parotitis in the Newborn, New England J. Med. **217**:351, 1937.

Kings County Hospital, however, only two cases of suppurative parotitis occurred.[40]

In treating sialadenitis, control of the infection, establishment of a free flow of saliva and relief from symptoms should be attempted. Sulfadiazine and penicillin [41] are effective in controlling the infection.[32c] Aureomycin may possibly be the drug of choice in the future, owing to its broader coverage in that it affects gram-positive and gram-negative bacteria and viral infections as well.

If suppuration has not occurred, hot, moist compresses should be applied to the involved area and warm mouth irrigations should be used. If suppuration has occurred drainage should be instituted. This procedure should be accomplished through the intraoral route when feasible.

Whenever the submaxillary gland is the site of an inflammatory reaction it should be watched closely. Since it is situated beneath the deep fascia, important clinical signs may be masked until the infection is far advanced. Frequent and careful interpretation and evaluation of existing clinical signs and symptoms is a necessity, with the thought kept in mind that early drainage when indicated is a most satisfying procedure. Whether to remove the gland or not is a debatable point. However, I believe that the gland should not be removed during an acute phase. Rather, the existing condition is treated until the infection has cleared and the edema has subsided; then, if one desires, the gland may be removed with impunity. Inasmuch as iodine is excreted by the salivary glands [42] it has been used for some time in the form of strong iodine solution (Lugol's solution) in treating uncomplicated sialadenitis.[43] Its use is two fold—for bacteriostasis and as a stimulus to salivary secretion. Radiation therapy has also been used, and many regard it as specific.[32]

Waldbott and Shea [44] reported several cases of parotitis that they considered to be on an allergic basis. They supported this theory with other cases from the literature. Treatment in such cases is directed toward the allergy.

---

40. Bloch, H., and Pacella, B. L.: Suppurative Parotitis of the Newborn, Arch. Pediat. **54**:681, 1937.

41. Vance, D. H., and Whitelaw, G. P.: Diffuse Deep Submaxillary Cellulitis Treated by Penicillin, U. S. Nav. M. Bull. **45**:542, 1945. Altemeier, W. A.: Penicillin in Surgery, South. M. J. **37**:494, 1944; footnote 38.

42. Goodman, L., and Gilman, A.: The Pharmacological Basis of Therapeutics: A Textbook of Pharmacology, Toxicology and Therapeutics for Physicians and Medical Students, New York, The Macmillan Company, 1941. Beck,[11] Altemeier,[32c] Seifert.[33]

43. Leithauser, D. J., and Cantor, M. O.: Lugol's Solution in Acute Secondary Parotitis, Ann. Surg. **101**:1171, 1935.

44. Waldbott, G. L., and Shea, J. J.: Allergic Parotitis, J. Allergy **18**:51, 1947.

F. SIALODOCHITIS

It is problematic whether inflammation of the salivary duct occurs without some involvement of the contiguous gland. As long as a free and copious flow of saliva prevails and the integrity of the lining epithelium is preserved, it is unlikely that inflammation of the duct will occur. Several primary forms of sialodochitis have been described.[45] Kussmaul,[46] in 1879, described a case characterized by sudden and recurrent attacks of bilateral obstruction of Stenson's duct caused by fibrin plugs; he termed this condition sialodochitis fibrinosa. Neuhof[22a] cited Noeggerath in describing a second type which is identical with the first, being differentiated by the absence of duct plugs. A third type reported by Neuhof is characterized by a cicatricial stenosis of one of Stenson's ducts (the opposite duct being normal), the result of inflammation of unknown origin. Secondary inflammation of the duct usually results from (*a*) an impacted calculus; (*b*) the introduction of a foreign body, or (*c*) the passage of a calculus.

Swinburne[22b] described a condition of the salivary system in which the ducts, ductules and even the terminal alveoli are dilated, resembling the dilatation of the bronchi and bronchioles in bronchiectasis. He termed this condition sialoangiectasis. It is probably the result of chronic infection with paroxysmal bouts of obstruction.

Sialoangiography as a diagnostic aid has been utilized by many authors.[47] The differentiation of benign and malignant tumors by this method is disappointing.[47a] Its greatest usefulness would seem to lie in demonstrating obstruction, stenosis or dilatation or abnormal communications of the duct system.

G. TUMORS

In a combined series of tumor cases, those in which the salivary glands were involved comprised from 1 to 2 per cent of the total.[48] In spite of their low incidence such tumors have stimulated a tremendous amount of interest and are probably the most debatable of all tumors. Their origin remains disputed, and their behavior makes the establish-

45. Wolf, G. D., and Soloway, D.: Sialodochitis: Diagnosis and Management, J. Am. Dent. A. **31**:1030, 1944.

46. Hoover, W. B.: Obstruction of the Salivary Ducts, Surg. Clin. North America **11**:303, 1931. Neuhof.[22a]

47. (*a*) Schulz, M. D., and Weisberger, D.: Sialogram in Diagnosis of Swelling About Glands, S. Clin. North America **27**:1156, 1947. (*b*) Payne, R. T.: Sialography: Its Technique and Application, Brit. J. Surg. **19**:142, 1931. (*c*) Kimm, H. T.; Spies, W. W., and Wolfe, J. J.: Sialography with Particular Reference to Neoplastic Disease, Am. J. Roentgenol. **34**:289, 1935. (*d*) Blady and Hocker.[20e]

48. (*a*) Payne, R. T.: The Diagnosis, Classification and Treatment of Tumours of the Salivary Glands; Symposium, Brit. J. Radiol. **17**:3, 1944. (*b*) Marshall, S. F., and Miles, G. O.: Tumors of the Submaxillary and Parotid Gland Areas, Surg. Clin. North America **27**:501, 1947.

ment of definite criteria of malignancy difficult. Unfortunately, one is unable to derive important statistical conclusions from combined case series, since the variety of classifications of salivary tumors renders any comparison of doubtful value.

Congenital.—(*a*) Hypertrophy: Simple hypertrophy in the glands has been recorded by Blandin and Nühn.[49a] It is extremely rare.

(*b*) Hemangioma: This tumor appears most commonly in the parotid gland,[49] where it may be either capillary or cavernous. If occurs most commonly during the first month of life. It may be treated by surgical procedure, when practicable; by external irradiation; by implantation of radon seeds, or by injection with one or another of the sclerosing agents.

(*c*) Lymphangioma: This tumor is limited almost exclusively to the parotid gland. It is compressible and soft and is important cosmetically. Treatment for this condition is the same as that outlined for hemangioma.

(*d*) Cysts: These are usually located in the parotid gland[50] and are probably due to blockage of a smaller ductule by incomplete liberation of saliva.

(*e*) Ranula: Congenital ranules are rare. Muller reported only five cases in 80,000 children examined.[51] They are benign cysts located in the sublingual ducts. Treatment is by excision.

(*f*) Other Tumors: Papiller reported a mixed tumor in a female infant of 11 months; McFarland in an infant less than one year of age, and Wood in an infant of 7 months. McKnight[52] reported an adenocarcinoma in a 15 month old infant. All these growths were tumors of the parotid gland.

Benign.—Pure adenomas rarely occur, and their existence is doubted by some authors.[53] They have been reported only in the parotid gland, and they are always encapsulated.[12] Papillary cystadenoma lymphomatosum (Warthin's tumor, adenolymphoma, oncocytoma) is one of the rarer of tumors.[54] The average age at onset is 52 years.[55] It is

49. (*a*) Walters, W., in Lewis, D.: Practice of Surgery, Hagerstown, Md., W. F. Prior Company, Inc., 1930, vol. 4. (*b*) Morris.[52a]

50. Leucutia.[12] Walters.[49a]

51. Kini, M. G.: A Case of Congenital Ranula of the Left Submaxillary Gland, Brit. J. Surg. **26**:947, 1939.

52. McKnight, H. A.: Malignant Parotid Tumors in the Newborn, Am. J. Surg. **45**:128, 1939.

53. Houck, J. W.: Tumors of the Salivary Glands, Surgery **6**:550, 1939.

54. Martin, H., and Ehrlich, H. E.: Papillary Cystadenoma Lymphomatosum (Warthin's Tumor) of the Parotid Salivary Gland, Surg., Gynec. & Obst. **79**:611, 1944.

55. Plaut, J. A.: Adenolymphoma of the Parotid Gland, Ann. Surg. **116**:43, 1942. Martin and Ehrlich.[54]

composed of a lymphadenoid stroma containing germinal centers with an epithelial structure in the form of tubular glands and cysts.[55]

Hamperl[56] found in the aging salivary glands a bizarre cell which he termed "onkocyte" and which he felt was significant for the origin of the adenolymphoma. Treatment is by simple excision. No malignant Warthin's tumor is reported in the literature, although local recurrence is possible. Acquired cysts may occur in the salivary glands, most frequently in the parotid. They usually arise in glands which have been the site of chronic inflammation, with resultant fibrosis and stenosis of the smaller ductules. Hydatid cysts have been found in the parotid gland, and up to 1939, 25 cases had been reported.[57] Isolated cases of fibroma and lipoma have also been reported.

Malignant and Mixed Tumors.—The majority of malignant salivary tumors are adenocarcinoma, although cuboidal cell carcinoma arises from the ductal system. Small cell carcinoma of Chevasse and basal cell carcinoma may also occur. Squamous cell carcinoma may arise as a primary growth in the salivary gland, but the fact that it may well represent a metastasis should be considered. Although sarcoma and melanoma arise in the salivary regions they are not true salivary tumors and will not be discussed here. Carcinoma of the salivary glands has been reported as occurring in the first[52] through the eighth decade of life[58]; it occurs most commonly after the fourth decade of life.[59]

Mixed tumors are still somewhat of a pathological enigma. There are two current diverging theories which attempt to explain their histogenesis. Briefly, they are as follows. The single tissue theory states that the tumors arise from the epithelium of the salivary glands. It has been shown that mucous tissue and cartilage may be derived from this epithelium.[60] It also states that these growths may possibly arise from misplaced or embryonic portions of gland tissue.

---

56. Kingsbury, B. F.: Lymphatic Tissue and Regressive Structure with Particular Reference to Degeneration of Glands, Am. J. Anat. **77**:159, 1945.

57. Martini, D.: Sulle cisti da echinococco della parotide, Riforma med. **61**:265, 1947. Payne.[45a]

58. Stein, I., and Geschickter, C. F.: Tumors of the Parotid Gland, Arch. Surg. **28**:492 (March) 1934.

59. (*a*) Taylor, G. W., and Garcelon, G. G.: Tumors of Salivary Gland Origin, New England J. Med. **238**:766, 1948. (*b*) Burch, J. C., and Fisher, H. C.: The Problem of Parotid Tumors, Surg. Clin. North America **26**:489, 1946. (*c*) Schulz and Weisberger.[47a]

60. Kaufmann, E.: Lehrbuch der speziellen pathologischen Anatomie für Studierende und Aerzte, 1923, vol. 1. Marchand: Ueber die sogenannten Endotheliome der Speicheldrüsen und die epitheliale Mesenchymbildung, Verhandl. d. Gesellsch. deutsch. Naturf. u. Aerzte **82**(pt. 2):1, 1911. Forman, J., and Warren, J. H.: The So-Called Mixed Tumors of the Salivary Glands, Ann. Surg. **67**:67, 1918.

The second theory, that of combined tissue origin, states that the tumors arise from ectodermal anl mesenchymal elements.[61] This theory more conveniently explains the fibroepithelial components. Irrespective of their histogenesis, mixed tumors consist of both epithelial and mesenchymal elements. Aggregations of epithelial cells with a variable cellular pattern and arrangement are incorporated in a stroma which is characteristically chondromyxomatous.[62]

The clinical differentiation of mixed tumors and carcinoma is usually impossible; however, some assistance may be obtained from the following differential points.

1. Age: The average age at onset of mixed tumors in Ahlbom's series [53] was 37 years and of malignant tumors 46 years. Marshall and Miles [45b] reported 45 years as the average age at onset for benign tumors and 48 for malignant tumors. Either type of tumor may occur at any age, however.

2. Duration of Tumor Before Operation: The average duration is approximately the same for benign and malignant tumors, according to Houck,[53] although other writers [63] noticed a shorter interval in the malignant group. By and large, the duration is an inconclusive point.

3. Physical Characteristics: In general, mixed tumors are more sharply defined and firm; they are not hard and are movable. Malignant tumors, on the other hand, are usually less sharply defined, reported as hard rather than firm and are usually fixed. Neither fixation nor consistency are signs of early malignancy and are, therefore, of questionable differential value.

4. Seventh Nerve Involvement: Such involvement is more apt to occur in malignant tumors. Taylor and Garcelon [59a] reported involvement of the facial nerve in 25 per cent of the cases of carcinoma and not once in mixed tumors.

5. Metastasis: In one series [59a] cervical node enlargement was noted in four cases of mixed tumor and 29 cases of carcinoma. Houck [53] reported that 20 per cent of the malignant tumors present cervical lymph node involvement; this rate is consistent with Payne's [45a] observations. Interestingly enough, and certainly fortunate, is the observation that malignant salivary tumors metastasize less widely than most malignant growths. The lungs and pleura are said to be the commonest sites of visceral metastasis.[45a]

---

61. Li, P. L., and Yang, C. S.: An Inquiry into the Origin of the Mixed Tumors of the Salivary Glands, with Reference to Their Embryonic Interrelationships, Am. J. Cancer **25**:259, 1935.

62. Hemplemann, L. H., and Womack, N. A.: The Pathogenesis of Mixed Tumors of the Salivary Gland Type, Ann. Surg. **116**:34, 1942.

63. Taylor and Garcelon.[59a] Marshall and Miles.[45b]

6. Subjective Symptoms: These are commoner in malignant tumors.

Classification.—Histopathological study of tumors arising in other locations has been rewarded with classifications which enable the physician to predict an approximate clinical course and prognosis. This ease of classification does not exist, however, in cases of salivary tumors.

Houck [63] classified salivary tumors into four groups on the basis of size and fixation, ranging from small and movable in group 1 to 4 cm. or larger and fixed in group 4. According to Houck, this grouping permitted an estimation of malignancy and prognosis.

McFarland [64] stated the belief that microscopic examination was of assistance only in determining the essential nature of the tumor. He classified tumors either as mixed or as carcinoma, and all mixed tumors were considered potentially malignant.

Patey [65] classified salivary tumors into four groups on the basis of cellularity. He found that malignancy varied directly with the degree of cellularity and differentiation of the cells.

Treatment.—No clearcut single form of treatment can be advocated which would be applicable to all salivary tumors. Obviously, the operative treatment of parotid tumors differs technically from those in the submaxillary and sublingual glands. In general, wide surgical excision of tumors of the neck may involve the removal of important nerves and blood vessels, with resultant disfigurement. Recurrence is frequent after surgical treatment. McFarland [66] reported a recurrence rate of 21.5 per cent and Wood a rate of 45 per cent [67] in mixed tumors. Stein and Geschickter [58] reported a 100 per cent rate of recurrence after curettage; 57 per cent after simple enucleation, and 13 per cent after removal with a cuff of normal tissue. Surgical procedures of varying magnitude have been the most popular form of treatment. Too often surgical procedure has been merely a token gesture on the part of the operator. Complete removal has been avoided, either from fear of injury to the facial nerve or because of fixation of the tumor to deeper structures. Since the microscopic diagnosis of whether a tumor is benign or malignant is many times inconclusive, preliminary biopsy is to be condemned. McFarland and associates [66] reported that violation of the protective capsule and operative trauma may increase the rate of growth and invasive tendency. Complete excision by sharp dissection is the

64. McFarland, J.: Tumors of the Parotid Region, Surg., Gynec. & Obst. **57**:104, 1933.

65. Patey, D. H.: Mixed Tumors of the Salivary Glands, Brit. J. Surg. **18**:241, 1930.

66. McFarland, J.; Ciccone, E. F., and Gelehrter, J.: On the Dysontogenetic Origin of Basal Cell Carcinoma, Am. J. Cancer **25**:273, 1935.

67. Wood, F. C.: Mixed Tumors of the Salivary Glands, Ann. Surg. **39**:57, 1904.

procedure of choice. Simple extracapsular enucleation is popular since it spares the facial nerve; however, it permits a high recurrence rate. Intracapsular excision with curettage is to be condemned since it is followed by the highest recurrence rate. Stein and Geschickter [58] showed that the high recurrence rate was due to the presence of tumor cells in the capsule.

Irradiation, both external and interstitial, has been used for some time, and certain conclusions have evolved. As the only form of therapy it is disappointing and of little benefit.[68] Benign mixed tumors are essentially ray-resistant.[58] Used entirely as a preoperative adjunct, irradiation may have the following advantages. It may (*a*) eliminate nonsalivary conditions, (*b*) cause some regression in tumor size and (*c*) toughen the capsule, thereby facilitating excision.

Ahlbom [53] strongly advocated preoperative irradiation and postoperative implantation of radium in the wound. In a five year follow-up observation period, there was a 2.5 per cent rate of recurrence for mixed tumors. Tod [69] reported a five year recurrence rate 2 per cent with the same method. Tod stated, however, that a five year follow-up period is unsatisfactory, since these tumors may recur as late as 20 years after excision.[69]

Postoperative complications include (*a*) facial nerve paralysis, which varies from 13.7 to 16.9 per cent [58]; (*b*) salivary fistulas; (*c*) anklyosis of the jaw, and (*d*) recurrence.

Prognosis is extremely difficult as recurrences have been reported 47 years after removal.[53] Ahlbom estimated that from 20 to 25 per cent of benign tumors treated by operation alone recur within three years. Using a combination of operation and irradiation, he found a recurrence rate of only 3 per cent at the end of three years. Of malignant tumors treated by combination of operation and irradiation there was a 42 per cent recurrence rate at the end of two years.[58]

H. FUNCTIONAL DISTURBANCES

Ptyalism is a condition of overactivity of the salivary glands. It may be the result of such factors as nervous instability, drugs and chemicals. Among the agents causing increased ptyalism are gold, mercury, iodide, bromide, arsenic, potassium chlorate, bismuth, lead muscarine, tobacco and pilocarpine.[70] Treatment is elimination of the causative agent

68. McFarland, J.: Three Hundred Mixed Tumors of the Salivary Glands of Which Sixty-Nine Recurred, Surg., Gynec. & Obst. **63**:457, 1936.

69. Tod, M. C.: The Diagnosis, Classification and Treatment of Tumors of the Salivary Glands; Symposium, Brit. J. Radiol. **17**:6, 1944.

70. Furstenberg, A. C., and Crosby, E.: Functional Disturbances of the Salivary Glands, Ann. Otol., Rhin. & Laryng. **54**:243, 1945.

together with small doses of atropine. A case was reported of troublesome ptyalism associated with cancer of the esophagus in which relief was gained by neurotomy of the auriculotemporal nerve.[71]

Xerostomia is a rare condition in which all salivary secretion is greatly diminished. Little is known concerning the cause of true xerostomia, but a relative xerostomia may be induced by habitual use of opiates or belladonna. Treatment is by discontinuance of the drugs, use of pilocarpine and chewing gum and liberal fluid intake.

TRAUMA

The salivary ducts may be injured from direct trauma or, secondarily, by an unrelated surgical procedure. Internal fistulas pose no great problem; however, ascending infection with recurring sialadenitis may occur in the absence of a papilla.[72] External fistulas of the submaxillary gland or duct may be treated by simple excision of the contiguous gland. The treatment of external fistulas involving the parotid gland and duct is a different matter, however, since the results of surgical repair of Stenson's duct have been notoriously poor. Discussion of injuries to the parotid duct will be facilitated by dividing the duct into three main divisions (after Newman and Seabrook[72]).

1. *Fistula Adjacent to the Gland.*—When the fistula arises from a small ductule, spontaneous closure may be expected to occur rather frequently since secondary infection with resultant fibrous tissue formation and atrophy of the involved secretory epithelium will occur. If this does not occur, irradiation of the gland or application of a caustic may be tried. Excision of the gland is too formidable a procedure to be useful here.

2. *Fistula over the Masseter Muscle.*—This area is the most superficial part of the duct, and this condition probably accounts for its being the most frequent site of traumatic fistula.[72] If the duct is injured during an operative procedure or if it is seen within a few hours after a traumatic injury it may be treated by passing a small urethral catheter into the duct in a retrograde manner until the catheter exits at the duct orifice. The other end is threaded into the proximal duct. The portion of the catheter within the mouth is then brought out and taped to the cheek. The defect in the duct is repaired with fine silk sutures and the wound closed without drainage. The catheter may be withdrawn in five to seven days. If the injury is an old one, however, more elaborate methods are necessary.

71. Resano, J. H.: Surgical Therapy of Sialorrhea in Cancer of Esophagus by Neurotomy of Auriculo-Temporal Nerve, Prensa méd. argent. **31**:1534, 1944.

72. Newman, S. C., and Seabrook, D. B.: Management of Injuries to Stenson's Duct, Ann. Surg. **124**:544, 1946.

An injection is made into the tract with iodized oil (lipiodol®) for visualization of its course, and the oral opening is dilated daily with progressively larger bougies as far proximal as possible. Good oral hygiene is observed throughout, and penicillin treatment is begun the day prior to operation. At operation a probe is inserted into the oral opening and passed as far as possible. With the probe as a guide, an incision is then made over the probe and carried down to the duct. All cicatrix is removed from the duct ends; after this procedure a dowel is threaded first into the proximal duct, then through the distal duct and out into the mouth and taped to the cheek. The dowel may be tantalum wire, stainless steel,[72] silkworm gut [73] or a urethral catheter,[74] though the wire is preferable. The duct is then approximated with fine surgical gut sutures and the wound closed without drainage. The dowel is manipulated gently to and fro daily to prevent stasis; in addition, pilocarpine may be given in amounts of 10 mg. three times a day to stimulate a good flow of saliva. Newman and Seabrook [73] advocated leaving the dowel in situ for at least three weeks.

3. Fistulas Anterior to the Masseter Muscle.—These fistulas are treated by conversion of the external fistula to an internal one.[75]

SUMMARY

Diseases of the salivary glands are divided into nine main groups: congenital abnormalities; Mikulicz' disease and syndrome; uveoparotid fever; sialolithiasis and sialodolithiasis; sialadenitis; sialodochitis; tumors; functional disorders, and trauma.

Each group is discussed at length with provisions for symptomatology, methods of diagnosis and treatment, and in some cases there is discussion on prognosis. Pertinent statistics are included when their added weight was deemed necessary to establish a point. An extensive review of the literature to each group is given and should prove to be a helpful reference list.

---

73. Wallace, F. T.: Primary Repair of the Parotid Duct, Am. J. Surg. **70**:412, 1945.

74. Butler, E., and Guinan, E. R.: Successful Repair of Stenson's Duct, Surg. Clin. North America **13**:1291, 1933.

75. Thorek, M.: Modern Surgical Technique, Philadelphia, J. B. Lippincott Company, 1938, vol. 1, p. 276.

Case Reports

ASEPTIC LATERAL SINUS THROMBOSIS

GOODLATTE B. GILMORE, M.D.
AND
ALAN AUSTIN SCHEER, M.D.
NEW YORK

Occlusion of a lateral sinus by an infected clot is encountered with diminishing frequency as compared with its common occurrence before the days of chemotherapy. Of great rarity is aspetic thrombosis of this venous channel secondary to cranial trauma.

When infection is present, the clinical picture is one of sepsis. If the clot is sterile, the patient can be asymptomatic.

In 90 per cent of specimens we examined, the lumen of the right lateral sinus was larger than the left. With such inequality, occlusion of the left sinus will not cause the same degree of intracranial hypertension as results from a right sided thrombus. When thrombosis of the right lateral sinus is present and a small left sinus exists, the mastoid, parietal, frontal and occipital emissary veins on the left are too small to carry the additional venous return. Papilledema, retinal hemorrhages and optic atrophy are important diagnostic findings. A small internal jugular vein and thrombosis of the lateral sinus on the opposite side will also disturb the intracranial circulation, with resultant papilledema.

In Boyd's [1] description of the pathogenesis of vascular trauma, thrombocytes (platelets) rapidly adhere to the site of intimal injury. Thromboplastin is liberated, and the machinery of fibrin formation is set into motion. The red cells and leukocytes become entangled, and the resultant thrombus consists of thrombocytes, fibrin and a variable mixture of red cells and leukocytes. Organization of the thrombus begins at its attachment to the vessel wall and is a healing process. New capillaries and fibroblasts grow in from the wall of the vessel, forming a vascular connective tissue later replaced by fibrous tissue. If recanalization takes place the new channel is lined with endothelium.

Sutherland [2] stated the belief that the whirling or eddying of the blood in the ampulated portion of the jugular bulb predisposes the lateral sinus to thrombosis.

REPORT OF CASE

M. G., a white boy aged 7, was admitted to Morrisania City Hospital on Oct. 2, 1948, ½ hour after falling from a tree and striking his head on the pavement. He was stuporous and confused, but there had been no period of unconsciousness. A soft fluctuant swelling, the size of a walnut, was present over the left occipital area

From the Otolarnygologic Department, Morrisania City Hospital.

Read before the Bronx Otolaryngologic Society, Inc., May 24, 1949.

1. Boyd, W.: A Text-Book of Pathology: An Introduction to Medicine, Philadelphia, Lea & Febiger, 1932.

2. Sutherland, J. M.: Otitic Sinus Thrombosis, Arch. Otolaryng. **27**:11 (Jan.) 1938.

Fig. 1.—Depressed fracture through occipital bone.

Fig. 2.—Fracture line extending through left lateral sinus. Note the marked disproportion in the size of the two lateral sinuses. The left sinus is approximately twice the diameter of the right and is a direct extension of the superior sagittal sinus.

in the region of the lateral sinus. At this point a depressed fracture could be palpated. The papillary and fundus examinations indicated no abnormalities.

Roentgenograms of the skull revealed a depressed fracture of the lateral half of the left occipital bone extending into the left lateral sinus at its knee (figs. 1 and 2). A marked disproportion in the size of the two lateral sinuses is noted, the left being approximately twice the diameter of the right and appears to be a direct extension of the superior sagittal sinus. The junction of the sagittal and lateral sinus is more angulated on the right. The reverse is the commoner occurrence in anatomic findings.

The members of the neurosurgical service deemed surgical intervention unnecessary since normal cerebration rapidly returned. For the next three weeks the child was free from symptoms. Then the fundi began to show an increasing elevation of both optic disks together with flame-shaped retinal hemorrhages. A spinal tap revealed an initial pressure of 360 mm. of water. Compression of the internal jugular veins resulted in an increase of the spinal fluid pressure to 550 mm. of water on the right side and 450 mm. on the left.

Four days later, daily spinal taps for decompression were begun. The initial pressure was 550 mm. of water, and the removal of 7 cc. of fluid resulted in a drop to 260 mm. of water. The Toby-Ayer manometric test then produced a rise of pressure to 430 mm. of water on the right side and 300 mm. on the left. Within a few days compression of the right internal jugular vein caused an elevation of spinal fluid pressure to 550 mm. of water, and compression of the left produced no change. A similar result was obtained the day following and for 19 days thereafter. During this period the papilledema decreased and the retinal hemorrhages showed signs of resolution. The patient was alert at all times.

Evidence of recanalization of the lateral sinus followed in another few days. A rise from 200 mm. of water to 280 mm. followed compression of the left internal jugular vein.

The patient was discharged from the hospital and examined in the outpatient department at weekly intervals. The fundi were normal, and the child's general physical condition was excellent. On March 10, 1949 the spinal fluid pressure was 140 mm. of water. Compression of the right internal jugular vein resulted in a rise to 550 mm. of water. Compression on the left elevated the pressure to 340 mm. of water. Canalization of a previously thrombosed left lateral sinus now seemed practically complete.

Meltzer [3] considered the reliability of the Toby-Ayer manometric test correct in 75 to 80 per cent of his cases. It is particularly accurate in complete occlusion as contrasted with the partial blocking by a mural thrombus.

The existence of a concurrent post-traumatic hydrocephalus was considered. Normally, a balance between the production and absorption of spinal fluid is present. A head injury can upset this balance, causing an increased production of spinal fluid by the choroid plexus, a decreased absorption by the pacchionian bodies or both.

The major part of the clinical picture in this case was due to occlusion of the lateral sinus.

2940 Grand Concourse.

522 West End Avenue.

3. Meltzer, P. A.: Treatment of Thrombosis of the Lateral Sinus, Arch. Otolaryng. **22**:131 (Aug.) 1935.

DEATH FOLLOWING TONSILLECTOMY

G. W. TAYLOR, M.D.

PHILADELPHIA

The following case report of a death after tonsillectomy is presented largely because it serves to emphasize a number of important features in the immediate postoperative management of patients subjected to tonsillectomy under general anesthesia.

REPORT OF A CASE

E. C., a Negro child aged 7, female, was admitted to the hospital from the otolaryngology outpatient department with a history of frequent colds and sore throats for the past two years, snoring, mouth breathing and occasional cough. The most recent acute episode was said to have been about six weeks prior to her admission to the hospital. Physical examination revealed a thin, lethargic child but no obvious abnormalities of the heart, lungs or abdominal system. The tonsils were enlarged with considerable debris in the crypts and injection of the anterior pillars. The ears and nose showed no significant abnormalities. The adenoids were grossly enlarged to palpation. The laboratory data indicated 80 per cent hemoglobin, 6,500 white blood cells, bleeding time one minute, coagulation time five minutes; the results of a routine urinalysis were essentially within normal limits.

The patient was anesthetized with vinyl ether U. S. P. (vinethene®) and ether, and an endotracheal tube was inserted. Routine tonsillectomy and adenoidectomy were performed, during which time oxygen and ether was administered by the endotracheal tube. The surgeon encountered profuse bleeding from both tonsillar fossa and also the nasopharynx, necessitating ligatures in each fossa and a nasopharyngeal pack, which successfully controlled all bleeding. After tracheal aspiration, the endotracheal tube was removed and the patient moved out of the operating room to await recovery. Stertor noted at this time was attributed to a combination of a large, thick tongue and the postnasal pack. However, the patient's color was good, and a metal airway did not seem necessary.

During the period before recovery, the child was being observed at regular intervals by either a nurse or an anesthetist, but she was not under consecutive observation by any one person. The pulse range was 120 to 130, the quality being strong and full. In retrospect, this fact may have signified the impending anoxia, but at the time it was not appreciated as significant.

A student nurse noted that respiration was very labored, and cyanosis of the lips and nails was quite evident. She called the anesthetist, who found that respiration had ceased entirely when he arrived. He immediately started artificial respiration with face mask and positive pressure apparatus. However, respiratory exchange did not seem to be sufficient by this method, so the endotracheal tube was replaced. There was no obstruction by blood or secretions, and only a small amount of bloody mucous was present in the pharynx and hypopharynx. Artificial respiration with 100 per cent oxygen was then carried on by manual compression of the breathing bag. Good expansion of the chest was obtained with each compression. There was no improvement in the cyanosis, and the heart ceased to beat at approximately the time the airway was restored.

From the Department of Otolaryngology, Hospital of the University of Pennsylvania.

A general surgeon was summoned from an adjacent operating room, and within a few minutes he opened the chest and began manually compressing the heart. Good exposure was then obtained by extending the original incision, and 0.5 cc. of 1 : 1,000 dilution of epinephrine was injected directly into the myocardium. The heart began to beat but almost at once began to fibrillate. While manual compression was again being carried on, a small amount of procaine hydrochloride was dropped onto the heart. The resumption of fairly regular heartbeats followed, and after a short period of observation the thorax was closed. Artificial respiration was maintained continuously through the endotracheal tube, as cyanosis was still present and spontaneous respiration was not evident.

During the following four hour period, the patient was given 500 cc. of whole blood intravenously and phenylephrine hydrochloride (neo-synephrine hydrochloride®) and epinephrine intramuscularly at intervals. At no time was the blood pressure recordable, and the heart rate was in the range of 140 per minute, though often too weak to be recorded from the radial pulsation. More than two hours passed before any spontaneous respiratory motions occurred, and these were too feeble to insure any exchange. After the patient had remained in the same condition for more than four hours, it became evident from the deepening cyanosis and irregularities of the pulse that the heart was failing. More active resuscitative measures with the use of epinephrine and transfusion of whole blood were ineffectual, and shortly thereafter the patient died. An electrocardiogram taken immediately before death showed severe myocardial damage, with gross irregularity and the gradual cessation of cardiac action.

Autopsy (Dr. James Camp).—External Examination: The body was that of a Negro female child aged 7, weighing 22 Kg. and measuring 123 cm. in length. There was a recent incision over the anterior portion of the thorax on the left. There was no edema, icterus or palpable lymph nodes. Cyanosis of lips and nail beds was present.

Internal Examination: The abdomen was normal.

There was 300 cc. of bloody fluid in the left pleural cavity, and the left lung was collapsed. The right lung was normal.

The thymus was larger than normal, weighing 65 Gm. It appeared normal in shape, color and cut section.

The right lung weighed 147 Gm., the left, 115 Gm. The left lung had a smooth purplish pink surface. The posterior portions were dark and noncrepitant and did not float in water. Nodules were not palpable. The right lung was normal on cut surface.

The spleen weighed 68 Gm. It was increased in size and normal in shape. It had a smooth purplish gray surface, and on cut section the consistency was decreased and the pulp easily scraped away. The tissue was brick red; the follicles were large and prominent, and the trabeculae were indistinct.

The only other abnormalities were in the lymph nodes and the gastrointestinal tract. The mesenteric, abdominal and mediastinal nodes were all enlarged and were firm and pink. The lymphoid tissue of Peyer's patches was considerably larger than usual.

Microscopic Examination: Lungs: In the section from the right lung many of the alveoli were filled with edema fluid. In one large part of the section there were plasmacytes (plasma cells) and monocytes in many of the alveoli. There was also thickening of the septums by infiltration with monocytes and plasmacytes. In the sections from the left lung most of the alveoli were filled with edema fluid.

Spleen: The splenic follicles were enlarged and most of their centers composed of large, pale, loosely arranged cells, many of which showed degenerative changes.

Brain: In routine sections from the cortex there were patchy areas in which the cells were poorly stained. Dr. Lewey stated that this condition was compatible with early anoxia but not indicative of it.

Other structures: Sections from the ileum, lymph nodes and thymus all showed lymphoid hyperplasia.

Comment: The lymphoid tissue of this patient showed the generalized hyperplasia usually seen in children who die suddenly. There was an interstitial pneumonitis in the right lung, which must have existed prior to operation. The brain sections showed changes compatible with anoxia, though not pathognomonic. The child lived only four hours after the anoxia, which is not believed to be sufficient time for distinct anoxic changes to show up microscopically.[1]

GENERAL COMMENT

In the preoperative history, physical examination and laboratory studies there was nothing to distinguish this child from any of the hundreds of children subjected to tonsillectomy each year in this hospital. The operative procedure, while somewhat longer and requiring more hemostatic measures than usual, was no worse than is occasionally encountered and handled without difficulty. The first indication of serious trouble was the postoperative obstructive dyspnea, due to a large postnasal tampon and the heavy, thick tongue of this patient, although the degree of obstruction was not considered severe enough to warrant extra precautions. During the recovery period there was no one in constant attendance, though the patient was seen at frequent intervals by either the nurse or the anesthetist, and personnel trained in the use of the laryngoscope and endotracheal intubation were immediately available. After it was noted that respiration had ceased, probably five to ten minutes after the patient left the operating room, almost another minute passed before the airway could be restored. Also, after the cardiac arrest, at least three to five minutes were needed to open the chest and begin manual massage. The problem from this time on was one of maintaining pulmonary ventilation by artificial respiration and support of the circulatory system with transfusion and sympathomimetic stimulants.

This case illustrates primarily that no patient operated on under general anesthesia should be left alone during the recovery period, even though trained personnel may be nearby. Particularly is this true when a postnasal pack has been inserted, as such a pack not only blocks the nasal airways completely but pushes the soft palate downward toward the base of the tongue and may thus occlude the oral airway as well. Had a metal airway been inserted before this child left the operating room it is possible that she would have made an uneventful recovery.

When such situations do arise postoperatively, speed is the foremost essential in establishing an adequate airway. My experience has been that an endotracheal tube is the ideal way to promote rapid maximum oxygenation. Should cardiac arrest occur, the chest must be opened extremely rapidly and massage begun before cerebral changes due to anoxia become irreversible.

When this patient died despite the measures employed, it was concluded that the basic reason was the long preliminary period of anoxia, with resultant damage to cerebral circulatory and respiratory centers. It is theoretically possible that the generalized lymphoid hyperplasia and chronic interstitial pneumonitis of this particular patient were significantly related to her death, in that her ability to recover either from the anoxia or from the strenuous resuscitative measures may have been considerably lower than normal. However, these lesions could hardly have been concerned in the original respiratory and cardiac arrest, and no claim is made

1. Thorner, M. W., and Lewy, F. H.: The Effects of Repeated Anoxia on the Brain: A Histopathologic Study, J. A. M. A. **115**:1595 (Nov. 9) 1940.

that her death was the result of factors other than anoxia from obstruction of the airway.

This is a case which in past years might have been considered to come under the classification of status thymicolymphaticus propounded by Marine,[2] who stated, "status lymphaticus may be defined as a constitutional defect, usually congenital . . . and associated with lowered resistance or increased susceptibility to a great variety of nonspecific, physical and chemical agents."

A later paper by Taylor [3] on this subject disagreed with earlier workers and denied the existence of status lymphaticus as a clinical or pathologic entity.

The excellent recent review by Boyd [4] did not attempt to classify status thymicolymphaticus as a true demonstrable pathologic lesion. He did state clearly the view which is now widely held that certain persons exhibit ". . . hyperplasia of the lymphoid tissue of throat, nasopharynx, and intestine, and enlargement of cervical, thoracic, and abdominal lymph nodes." Further, according to Boyd, certain persons with these physical characteristics ". . . have a lowered resistance to drugs, poisons, and other harmful influences." Boyd's description of the microscopic picture of the lymphoid tissue in these cases is notable: "The germ follicles show replacement by whorl-like collections of spindle cells, among which are scattered large polyhedral forms. The cytoplasm of both these cells stains pink with eosin, so that the follicles stand out against the deep blue of the lymphocytes. In children the lymphoid tissue in fatal cases shows innumerable necroses of the germ follicles."

Sudden death in these cases is probably due to stoppage of the heart, possibly due to the release of nucleoproteins formed as the result of destruction of the follicles. Campbell [5] in an earlier paper discussed at length the intricacies of chemical and hormonal abnormalities in these cases, which could readily account for cardiac arrest.

Although the pathologic anatomy in the case reported here resembles in some respects that of many reports of sudden death in children, the cause of death seems too clearcut and the effects of anoxia too typical to consider the patient's own constitutional factors as anything of more than secondary importance. Also, the clinical course was not one of sudden death without explanation, and the histopathology differed in no way from that occurring in death from anoxia.

SUMMARY

A case in which death followed tonsillectomy is reported.

The following measures are suggested to prevent further similar episodes.

1. There should be adequate postoperative observation, especially so when a postnasal pack has been inserted.

2. The airway must be kept free and open by whatever means are necessary.

3. When accidents do occur, speed in reestablishing the airway and beginning cardiac massage is essential.

4. In the presence of ventricular fibrillation in this case, procaine hydrochloride was dropped onto the myocardium and was followed by cessation of fibrillation and resumption of cardiac action.

Recent thoughts concerning status lymphaticus are mentioned and points of difference between this and many earlier reports of fatalities noted.

3400 Spruce Street.

2. Marine, D.: Status Lymphaticus, Arch. Path. **5**:661 (April) 1928.

3. Taylor, J. F.: Proc. Roy. Soc. Med. **33**:119, 1939.

4. Boyd, W.: Surgical Pathology, ed. 6, Philadelphia, W. B. Saunders Company, 1946, pp. 595-597.

5. Campbell, E. H.: Causes of Death in Status Lymphaticus, Am. J. Dis. Child. **44**:1297 (Dec.) 1932.

CONGENITAL MALFORMATION OF THE EXTERNAL EAR AND ATRESIA OF THE AUDITORY CANAL

GEORGE B. FERGUSON, M.D.
AND
CARL N. PATTERSON, M.D.
DURHAM, N. C.

Bilateral atresia of the external auditory canal has long been a serious problem to the practicing otologist, and, through his efforts to restore some degree of hearing to the patient otherwise hopelessly deaf, many surgical procedures have been devised for its correction. Unfortunately, results of these procedures have been so unsatisfactory as to discourage attempts at surgical correction when the patient has one normal ear.

We wish to report, however, a case of unilateral atresia associated with external ear deformity in which careful examination suggested to us the probable presence of a normally functioning acoustic mechanism. We were encouraged by this examination to undertake surgical procedure, which, in this case, yielded restoration of normal hearing and an improved cosmetic result.

R. B. W., a white youth aged 19, was first seen by us on June 23, 1948, at which time he had acute otitis externa with marked swelling and occlusion of the left external ear canal and a temperature of 100 F. Congenital malformation of the external ear was noted. The patient was hospitalized immediately for local and general treatment. Triple sulfonamide tablets were prescribed in a dosage of 1 Gm. every four hours; but, on the following day, June 24, no improvement having been noted, penicillin was begun in a dosage of 300,000 units daily and continued in this dosage for six days. By June 26 the temperature had dropped to normal, where it remained, and the swelling had entirely subsided, so that complete atresia of the external canal could be noted. Roentgenograms taken on this date revealed normal cellular structure of the mastoid bones, with the external meatus appearing normal on the right side and indistinct on the left.

The left external ear presented a pit, a remnant of the first branchial groove, at the anterosuperior border of the helix. An accessory lobule and its cartilaginous attachment extended from the antihelix, just inferior to the fossa triangularis, and overlapped the tragus (fig. 1).

The ear canal ended blindly 6 mm. from the concha. After proper cleansing of the ear, a needle exploration was done to determine the character of the underlying structures and in the hope that external drainage could later be established.

The obstructing partition was found to contain bone, except for an area 3 mm. in diameter, which was composed wholly of soft tissue. Procaine was injected into this area, which was then opened with a knife. A small ear speculum was inserted, and the canal was found to be filled with detritus. The external canal was irrigated; after this procedure the speculum was again introduced, but no

From the McPherson Hospital.

underlying structures could then be identified. However, since an opening had been obtained, an audiogram was immediately done, and, to our surprise, it revealed normal hearing.

Reconstruction of the ear canal was therefore advised. We recognize the fact that in many cases of atresia no normal hearing mechanism is present. In this case, however, in spite of the fact that normal structures could not be visualized, it was felt that with a normal mastoid on roentgenogram and normal audiogram an excellent prognosis could be given.

OPERATION

On July 9, with analgesia (butethal [neonal®], pentobarbital sodium and meperidine hydrochloride [demerol hydrochloride®]) and 1 per cent procaine for local

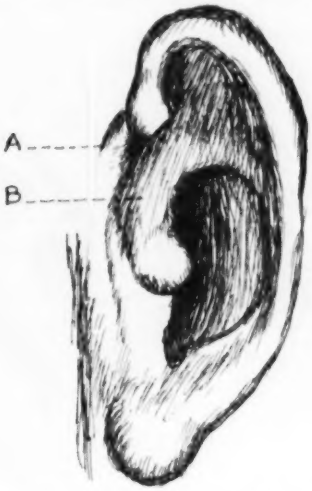


Fig. 1.—*A*, congenital fistula auris; *B*, accessory lobules and attachment.

anesthesia, plastic repair of the external ear and reconstruction of the auditory canal were done.

Plastic Repair.—An incision was made over the superior border of the large crus which, in this instance, represented the inferior limb of the antihelix. This incision was continued forward so as to excise the branchial pit. A large portion of underlying cartilage was excised, and the remainder was fashioned to resemble the inferior limb of a normal antihelix. The accessory lobule was removed, and the excess skin was used to restore the tragus. The skin was then closed with 000000 silk.

Reconstruction of the Auditory Canal.—The Lempert no. 1 incision was made along the posterior bony canal wall from 12:00 to 6:00 o'clock. The incision was continued toward the drum at 12:00 o'clock and the skin reflected away from the bony canal, which was found to be narrowed at its junction with the cartilaginous canal. A portion of superior wall was removed with a cutting burr, and a large

quantity of desquamated epithelium and wax could then be removed. The bony canal wall was polished and the skin flap restored to normal position; the canal was packed and a pressure dressing applied. We now feel that the application of a small split thickness skin graft might have prevented a subsequent slight contraction in the external canal.

Sutures were removed on the seventh postoperative day, and the canal appeared well open. On the seventeenth postoperative day the drum membrane was visualized for the first time. It appeared normal in structure and size. The audiogram revealed normal hearing, which, at this writing, has persisted for fourteen months.

EMBRYONAL DEVELOPMENT

One can find many excellent descriptions of embryonal development of the ear, and no endeavor will be made here to discuss this problem in detail. How-

Fig. 2.—Cross section showing area of atresia.

ever, to make clear the congenital malformations that occurred in this case, a summary is given.[1]

The inner ear develops first from an ectodermal otic placode. This placode invaginates to form an otocyst which differentiates into a vestibular and a cochlear component before either the middle or external ear is formed; hence, congenital malformation of the internal, middle and external ear may occur independently or together.

The middle ear cavity and eustachian tube develop as a lateral extension of the first pharyngeal pouch. Early in development the entodermal pouch is in contact with the ectoderm of the first branchial groove, but later, with continuing growth of the head, they are separated by the ingrowth of mesoderm, which forms the

1. Van Alyea, O. E.: Embryology of the Ear, Nose and Throat, Section on Instruction, American Academy of Ophthalmology and Otolaryngology, 1944.

primordia of the middle ear ossicles. The malleus and incus are derived from the first branchial arch (Meckel's cartilage); the stapes arises from the second arch (Reichert's cartilage).

The external auditory canal develops from the first branchial groove. The primordia of the first branchial groove and first pharyngeal pouch are in contact but separate to join later. At first, the branchial groove deepens to form a primitive external meatus. An ectodermal plate (meatus plate) breaks off and grows inward to make contact with the entoderm, forming the middle ear cavity. The auditory canal remains closed until about the seventh fetal month when canalization normally occurs. The growth of hair and glands is limited to the primitive meatus. The pinna is derived from six tubercles. Three tubercles are derived from the mandibular arch and three from the hyoid arch. The tragus and helix are formed from the first three and the antihelix, antitragus and lobule from the latter three tubercles.

To understand the congenital malformations occurring in this case, one must suppose that the primordial tubercules that normally form the antihelix, antitragus and lobule (derived from the hyoid arch) subdivided so as to form an accessory antihelix and lobule. The partition that was found in the auditory canal represented the incomplete canalization of the meatus plate.

SUMMARY

1. A case of unilateral congenital external ear and auditory canal deformity is presented.

2. Needle exploration in this case yielded findings which warranted surgical intervention. This intervention resulted in the restoration of normal hearing and in the adequate drainage of the external canal.

3. The appearance of this man was improved by plastic procedure.

MENINGITIS, PNEUMOCOCCIC TYPE 3; MASTOIDECTOMY, RECOVERY

BENJAMIN H. SHUSTER, M.D.
AND
WILLIAM GORDON, M.D.
PHILADELPHIA

E. B., a man aged 65, was admitted to the medical service of Dr. Harrison F. Flippin, on Jan. 21, 1948. The patient was stuporous. No history was obtainable. He was found violent and agitated on the morning of admission.

Physical examination revealed a temperature of 105 F., with a pulse rate of 120 and respiration rate of 25. His blood pressure was 170/120. Extreme nuchal rigidity was present. The pupils were equal; they did not respond to light and accommodation. There was bilateral arcus senilis. Examination of the eyegrounds could not be made because of the restlessness of the patient.

Examination of the nose indicated nothing abnormal.

There was bilateral postauricular redness. Further examination of the ears was not made.

The oral, faucial and pharyngeal structures were not visualized because of the condition of the patient.

The trachea was in the midline. The veins were distended, and nuchal rigidity was present.

The lungs were clear except for a few basal rales. The heart was enlarged on the left; the beat was 100 and regular, with a systolic murmur at the base.

Nothing abnormal was indicated on examination of the abdomen and the extremities.

Neurologic examination showed that the deep tendon reflexes were present and equal. There was extreme nuchal rigidity, as was stated before. Hoffman and Babinski signs were not elicited.

A spinal tap was performed, and purulent fluid under increased pressure was obtained. This specimen was sent to the laboratory, and the report disclosed the presence of 26,600 cells per cubic millimeter; 99.9 per cent polymorphonuclear leukocytes, and 0.1 per cent lymphocytes; the bacteriologic examination revealed gram-positive diplococci, pneumococcus type 3.

Urinalysis indicated the presence of albumin but not of sugar. The red cell count was 3,000,000 to 5,000,000, per high power field. The leukocyte count was 18,000, with 94 per cent segmented granulocytes (polymorphonuclear cells) and 6 per cent lymphocytes.

This diagnostic work-up was accomplished in a little more than three hours after the patient's admission, and a diagnosis of meningitis with the pneumococcus type 3 was made.

Read before the Philadelphia Laryngological Society, March 2, 1948.

From the Medical Service of Dr. Harrison F. Flippin, Philadelphia General Hospital.

The otolaryngologic service of one of us (B. H. S.) then received a request for opinion and advice.

Examination of both ears revealed the following results: In the right ear the canal was moist, and some epidermal debris was removed. Thin secretion drained from the middle ear, but the exact locality of the perforation of the drum membrane could not be made out. In the left ear a large piece of cerumen was easily removed, and the drum membrane was found to be normal.

Just as these notes were completed, a relative of the patient came to visit him and, on questioning, reported that the patient had had otorrhea of the right ear for at least two months; that he was otherwise well, but became stuporous and was admitted to the hospital. This information proved to be the only history obtained.

The recommendations, from the otic point of view, were as follows: "In view of the findings and the patient's present state of being, we advise immediate roentgenograms of the mastoids and preparation for right mastoidectomy." The roentgenologic report stated that "Comparison of both sides shows what appears to be clouding of the right mastoid, which is presumptive evidence of mastoid involvement."

The patient's blood was type B, and a donor with type O was obtained for future transfusion.

The patient was prepared for mastoidectomy of the right ear, and since anesthesia in these cases poses a serious problem, the choice of the anesthetic and the management thereof was left to the chief of the department of anesthesiology, Dr. J. Eugene Ruben. The temperature was 106 F; the pulse rate, 150, and the respiration rate 50.

OPERATIVE PROCEDURE AND FINDINGS

With the administration of cyclopropane, a postauricular incision was made on the right. The antrum was defined, and soft, devitalized cells of the periantral area, the trough, the posterior canal wall and zygoma region were cleaned away. The bone of the dural plate seemed to be of good quality, but this was removed in order to investigate the dura and to permit an appreciably wide exposure. The dura was under slight tension, if any, and appeared normal.

The lateral sinus plate seemed normal, but devitalized cells were found anterior to it and at the sinodural angle and were cleaned away. The lateral sinus was exposed from its uppermost part to below its knee and found to be normal. Many soft cells were cleaned away anterior to the knee. The tip of the mastoid process was broken into, and about 2 cc. of purulent material was obtained from a large cell.

In the removal of infected cells, every effort was made to smooth away all projections, bulges, overhangs and shelvings as well as to effect as wide an exposure of the middle and posterior fossae as possible.

The operation lasted two hours. The wound was left open and a dressing applied over it. The patient was returned to the ward in a critical condition, with a temperature of 103 F., a pulse rate of 120 and a respiration rate of 40.

Postoperative Observation by Dr. Zibold.—The patient seemed better the following morning (January 22). He responded to slight stimulation, though prior to operation he was deeply comatose and failed to respond to painful stimuli. He had a facial weakness on the right and a right internal strabismus when the eyes were turned down. The lungs were clear except for some crackling rales at the left base. Tachycardia with frequent extrasystoles persisted. The abdomen was soft, and the bladder was distended. Tendon reflexes were absent. His temperature was 101 F. The bandages were soaked with blood.

Though the patient reacted more readily to any stimulation, he would revert to the stuporous state when left alone. At times he showed a rage response, hyperventilating and grinding his teeth. An indwelling urethral catheter was inserted. His temperature was 100 F.

The wound was reinspected on the third postoperative day (January 24). The wide exposure of the dura in the middle fossa showed that it was not under tension; hence an abscess was unlikely.

With the patient in bed and semiconscious, a nibble of bone in the posterior fossa was removed with the rongeur. The dura in front of the lateral sinus was separated from the petrous bone. It was not under tension, nor was an extradural abscess found. A slight tear in the dura released cerebrospinal fluid (this excluded a likelihood of an anterior cerebellar abscess). This release of fluid under pressure might well have been the turning point of this patient's recovery. Eagleton some years ago reported recoveries in cases of meningitis (before the days of antibiotic therapy) which could be attributed to the facilitation of drainage of the pontile cisterna. Shortly after this procedure the patient's cerebration and sensorium improved and assumed a more normal aspect.

Progress Notes.—The wound was redressed every other day and the iodoform pack changed. It was noted that efficient healing was proceeding normally. The facial paresis cleared up completely on the sixteenth postoperative day (February 6). After that date no more packing was inserted and the wound was permitted to close.

The patient received 50,000 units of penicillin sodium intramuscularly every three hours around the clock for 17 days after the operation, a total of 6,800,000 units. Sulfadiazine (1 Gm.) and sulfathiazole (1 Gm.) with sodium bicarbonate (2 Gm.) were administered every four hours around the clock for one week, after which the dose was reduced one half and discontinued after the second week. Oxygen was supplied by nasal catheter and continued intermittently for the first week. Intravenously, 1,000 cc. of 5 per cent glucose in distilled water was given at six hour intervals for three days. On the third and fourth postoperative day (January 24 and 25), 20,000 units of penicillin sodium in 3 cc. of saline solution were given intrathecally.

The fifth postoperative day (January 26) marked the first time that the patient was able to take nourishment by mouth. He was given high caloric nutritive fluids, which he retained and absorbed. Soft diet and regular house diet were prescribed on the eighth and tenth postoperative days respectively.

The temperature, pulse rate and respiration rate, which reached the peak of 106 F., 150 and 50, respectively, at operation declined to 101 F., 130 and 40 on the first postoperative day (January 22) and returned to normal five days later.

The patient recovered fully on the eighteenth postoperative day (February 8) and was referred to the medical service for rehabilitation.

Several urine examinations made after the fifth postoperative day disclosed no albumin or white and red cells per high power field. On this date the bacteriologic examination of the cerebrospinal fluid showed no growth.

SUMMARY AND CONCLUSIONS

A case of meningitis with pneumococcus type 3 in a man 65 years of age is reported. The patient was admitted in a stuporous condition on Jan. 21, 1948, and a complete work-up was accomplished by the medical service without the aid of a history. A simple mastoidectomy on the right was performed to allow free

drainage and wide exposure of the middle and posterior fossae. The patient was in the hospital less than 12 hours when this procedure was completed.

The medical service gave the patient vigorous support in maintaining effective fluids, hydration, nutrition, oxygen, chemotherapy, electrolytes and antibiotic blood levels. The patient improved gradually at first and more speedily on the seventh postoperative day, and recovery seemed assured on the seventeenth postoperative day (February 7). The day after that he was referred for rehabilitation.

Much of the dispatch with which the treatment of this case was executed was due to the sentiment of Dr. Flippin concerning the problem of pneumococcic meningitis. He has felt for a long time that patients with this condition should be subjected to a bilateral mastoidectomy regardless of whether morbid processes can be demonstrated in the mastoids or not, on the basis that the infection originated in the nose and nasopharynx and reached the meninges by way of the middle ear and the mastoid.

This view may appear radical and difficult to accept; yet it has been Dr. Flippin's experience that unless the mastoids are treated surgically, recovery for these patients is hopeless. He has observed that the mortality rate in cases with no operative procedure in which treatment is by antibiotics alone is 80 per cent.

The finding of an active suppurative otitis media in this case made the acceptance of this viewpoint easier, and the eventual outcome proved the correctness of the idea.

1824 Pine Street.

5345 Spruce Street.

News and Comment

MEETING OF THE INTERNATIONAL COLLEGE OF SURGEONS

The fifteenth annual assembly of the United States Chapter of the International College of Surgeons will be held in Cleveland, October 31 to November 3, with headquarters at the Cleveland Hotel.

Surgical clinics will be held in several Cleveland hospitals on Monday, October 30. All scientific sessions will be held at the Cleveland Public Auditorium from 9:00 a. m. to 5:00 p. m., Tuesday through Friday.

A colored television program of surgical procedures, originating from the St. Vincent Charity Hospital will be shown daily in the auditorium from 9:00 a. m. to 1:00 p. m. Motion pictures will also be presented each day depicting many of the recent advances in surgery and surgical technic. At the annual banquet, to be held at the Statler Hotel on Thursday evening, Dr. Frank Lahey, of Boston, will present an address entitled "Some of the Recent Advances in Surgery," and Dr. Elmer Henderson, President of the American Medical Association, will speak on "The Importance of International Cooperation in Surgery."

Reservations may be secured from the committee on hotels, International College of Surgeons, 511 Terminal Tower, Cleveland 13. Preliminary programs may be obtained from the central office, 1516 Lake Shore Drive, Chicago 10.

TRAINING IN OTOLARYNGOLOGY OFFERED BY THE ALASKA DEPARTMENT OF HEALTH

Arrangements have been made for training persons with at least one year of formal experience in ophthalmology and otolaryngology (or in each of the specialties separately) through a six months' affiliation with the consultant in these specialties in the Alaska Department of Health. These six months of training are accepted as part of the requirements for board certification in otolaryngology and ophthalmology. The American Board of Ophthalmology will accredit the affiliation if the resident program at any approved medical school will accept it.

The work involves air travel to the remote settlements in the Territory of Alaska with the surgical equipment necessary to perform the commoner eye, ear, nose and throat operations. Air transportation is used in almost all instances, though travel by boat, car, railroad and, occasionally, dogsled may be necessary. Clinical material is limitless.

The training is supervised by the consultant in ophthalmology and otolaryngology of the Alaska Department of Health. The consultant is certified by both boards.

Air transportation is supplied between the selected university and Alaska both ways. The stipend is $200.00 a month plus a per diem of $7.00 to $10.00, except when quarters are supplied at a government hospital.

Further information may be secured from Dr. Milo H. Fritz, Consultant in Ophthalmology and Otolaryngology, Alaska Department of Health, Box 808, Anchorage, Alaska.

Abstracts from Current Literature

Ear

THE PRESENT STATUS OF OBJECTIVE HEARING TESTS. H. G. KOBRAK, Ann. Otol., Rhino. & Laryng. **57**:1018 (Dec.) 1948.

The acoustic pupillary reflex, general muscular reflex and acoustic lid reflex have been the ones commonly used to demonstrate cochlear function. These are limited in applicability, and even negative findings do not rule out the presence of hearing.

The author's experiments with animals showed that the drum membrane appears immobile to ordinary observation even though the muscles of the middle ear are contracting to the stimulus of sound. If the stapedius tendon can be seen through a perforation and can be seen to contract, the presence of cochlear function is demonstrated. In some patients the tendon can be made visible through an intact drum membrane by inducing "artificial transparency." This cannot be successfully done in all ears, but in some it can by the application to the drum membrane of a mixture of glycerine, water and potassium iodide gently massaged into the drum membrane after anesthetizing it. This method of developing artificial transparency is not presented as a well founded clinical method but as an experimental attempt, by which it was possible to compare the numerous observations on pathologic ears with a few selected normal ears. In patients in whom the stapedius contractions are visible, or can be made visible, objective hearing tests can be performed (1) to demonstrate cochlear function in infants or those too young to give reliable responses in hearing tests; (2) to demonstrate cochlear function in psychiatric patients, and (3) to demonstrate cochlear function in malingering.

MILLER, Philadelphia.

CLINICAL STUDIES WITH PARENTERAL VITAMIN A THERAPY IN DEAFNESS. M. J. LOBEL, Eye, Ear, Nose & Throat Monthly **28**:213 (May) 1949.

The author presents a new therapeutic approach to the problem of deafness. His approach is based on the belief that there is a relation between nutrition and loss of hearing. Approximately 300 patients with progressive deafness have been studied and treated with an injectable vitamin A preparation. This product consists of olive oil, terpins and the A factor of a concentration of 50,000 units per cubic centimeter.

The author states that an appreciable gain in hearing was obtained in hard of hearing patients treated for a prolonged period (more than five months). Tinnitus was relieved in many patients after less than two months of therapy. The response to vitamin A therapy was found to be more pronounced in the so-called catarrhal form of deafness. The perceptive type of deafness was slower to respond, but even in these cases a favorable change may eventually take place.

JENNES, Waterbury, Conn.

DEAFNESS AS IT OCCURS IN VARIOUS AGE GROUPS. C. STEWART NASH, New York State J. Med. **49**: 2409 (Oct. 15) 1949.

From the department of otolaryngology, University of Rochester School of Medicine and Dentistry, Dr. Nash presented a paper before the New York State Medical Society, at Buffalo, May 6, 1949. He urged early diagnosis, at least

during the first or second year when the deafness is correctable. Early diagnosis is a responsibility of parents, teachers and nurses but especially of otologists. The Spencer Tracys established the John Tracy Clinic in Los Angeles when an otologist told them that nothing could be done about their son's deafness.

The neglected remedial deafness of today may be the permanent disability of tomorrow. For achieving the diagnosis, every factor must be thoroughly examined: the external meatus, the drum membrane, the ossicular chain, the presence or absence of air in the tympanic cavity, the state of the organ of Corti, the functionability of the auditory nerve and the capacity of the higher centers (brain and pathways) to interpret sound.

For the congenitally deaf there are now "aids" and educational facilities. For the 2 ½ to 12 year old children, the tonsils and adenoids must be removed thoroughly, and it must be ascertained that the eustachian tubes are patent after operation. Eustachian tube deafness is curable. From the age of 12 to 20 osteoporosis and otosclerosis are common, and when the footplate of the stapes becomes fixed, fenestration is to be considered. In the 20 to 40 age period, one must look out for an arthritic or rheumatoid cause. Between the ages of 40 to 60, arteriosclerosis may be responsible. Here vitamin B can be useful. Just why or how vitamin B works is problematic, but its administration does seem to be effective at times.

Irrespective of age groups, one must keep in mind such causes of deafness as toxins formed in the body through infectious diseases. The toxins of such conditions as measles, scarlet fever, pneumonia, mumps, encephalitis and meningitis are effective in producing pathologic changes in any of the sense organs. These are perhaps the most vicious causes of deafness. The resultant deafness is always dependent on nerve degeneration and is, therefore, irreversible.

Drug deafness has long been known. Prolonged administration of quinine has caused deafness, usually accompanied with ringing in the ears. Whether the newer analogous agents used in malaria, such as atabrine, will have a similar effect, has not as yet been determined, or, at least, has not been generally reported.

Recently, deafness after administration of streptomycin has been described. It is severe and seems to be permanent. However, it may be the price which must be paid for saving a life.

In the discussion, Dr. Greydon Gill Boyd, of New York, said that "For the acoustically handicapped, audiology is the avenue to learning, earning and discerning."

I. W. VOORHEES, New York.

CHRONIC SECRETORY OTITIS MEDIA. RAY JORDAN, Laryngoscope **59**:1002 (Sept.) 1949.

The cause of chronic secretory otitis media is the closure of the eustachian tube. Allergy was the etiologic factor in three quarters of the cases in this series, whereas in a little less than one quarter was the cause chronic infection. Diseased adenoids accounted for only 3 per cent of the cases.

Symptoms include loss of hearing, earache, frequent colds and aural stuffiness. A yellowish cast and a slightly retracted drum membrane were the most constant physical signs. Bubbles were often seen after inflation. Paracentesis produces a straw-colored fluid.

Irradiation produced only temporary relief, as was expected from histologic studies on irradiated lymphoid tissue made by Jordan. Permanent relief was best obtained by treatment of the allergy.

HITSCHLER, Philadelphia.

NASOPHARYNGEAL IRRADIATION AND HEARING ACUITY: A FOLLOW-UP STUDY OF CHILDREN. STACY R. GUILD, Laryngoscope **60**:55 (Jan.) 1950.

Guild studied the end results of irradiation of the nasopharynx and found that some of the previous conclusions were apparently erroneous. For example, those children with high tone loss who were irradiated showed after 6½ years (average) only the same slight gain in hearing as did the untreated ones. However, those with a "flat" loss showed real improvement after irradiation of the nasopharynx.

HITSCHLER, Philadelphia.

INDICATIONS FOR LABYRINTHOTOMY AND THE OPPORTUNITY FOR EARLY PERFORMANCE OF THE RADICAL OPERATION IN CASES OF ACUTE LABYRINTHITIS DUE TO REACTIVATED CHRONIC OTOMASTOIDITIS. P. P. BRANCHI, Oto-rino-laring. ital. **15**:427, 1947.

Excellent results were obtained by the author in five cases of chronic purulent otomastoiditis with acute manifestations of labyrinthitis. He treated the patients with the conservative method first advocated by Citelli: bed rest, sulfonamides and radical mastoidectomy when the acute labyrinthitis had subsided. There were no recurrences.

MELUCCI, Philadelphia.

LATE MENINGITIS FROM PREVIOUS FRACTURE OF THE TEMPORAL BONE. C. JEMMI, Oto-rino-laring. ital. **17**:15, 1948.

In the experience of the author, fractures of the temporal bone involving the labyrinth may favor meningeal complications even after months or years.

In older subjects the new production of connective tissue for the repair of the fracture brings about degeneration of the nerve elements, with consequent deafness. Therefore, in cases of trauma of the temporal bone, especially if the subject is affected with otitis media, a long period of medical follow-up is advisable, and surgical procedure may be indicated regardless of the endocranial effects of the trauma. For the medicolegal aspect of the problem, consideration must be given to these possibilities, and, in case of death after a period of time, accurate examination of the temporal bone may be necessary and useful.

MELUCCI, Philadelphia.

OTOGENOUS MENINGITIS DUE TO KLEBSIELLA CURED WITH STREPTOMYCIN. R. ROSSI, Oto-rino-laring. ital. **17**:428, 1948.

The author describes a rare case of meningitis, the etiologic factor of which was the Klebsiella pneumoniae, that was successfully treated with streptomycin.

After a few days of suppurative otitis media, unresponsive to paracentesis, penicillin and sulfonamides, the patient was operated on. A simple mastoidectomy was performed. Far from any improvement being obtained after 24 hours, the picture had become one of a purulent meningitis. Revision of the mastoid for possible residual diseased cells was unrevealing. Pure culture of K. pneumoniae was obtained from the seeding of spinal fluid on agar serum. Streptomycin therapy (2 Gm. intramuscularly and 50 mg. intrathecally daily) was instituted, with immediate subjective improvement. The spinal fluid findings reverted to normal, and complete recovery took place within six days.

MELUCCI, Philadelphia.

RELATIVE RISKS OF CHRONIC AND ACUTE OTITIS. MARCUS DAMIANT, Acta oto-laryng. **36**:520 (Sept.-Dec.) 1948.

The author uses the statistical method in studying the averages and standard deviations of the size of the air cells in the mastoid bone. Measurements were made by a planimeter with the roentgenographic technic. The observed findings were then correlated with the incidence of chronic and acute otitis media and the result noted. Statistics were drawn from a statistical sample of conscripts.

He points out that the risk of disease is greatest with small cellular systems and that the larger the cellular system the less the risk of either acute or chronic disease. It is his interpretation of events that otitis in childhood or later life is specifically the consequence of an inherited small cellular system. The governing factor is the hereditary size of the cells. ROBERT LEWY, Chicago.

CONCERNING TASTE DISTURBANCE AFTER OPERATION FOR OTOSCLEROSIS. ERNST DUBENDORFER, Acta oto-laryng. **37**:172 (April) 1949.

The author states that several times in the literature of ear disease taste disturbances have been reported following acute and chronic middle ear infections as well as radical mastoidectomies. These changes are presumed to be due to damage to the chorda tympani in its course through the middle ear. In a recent article, without enlarging on the subject, Jannulis stated that this may also occur after fenestration operations.

The author tested the taste sensation of 25 fenestrated patients and of 31 who had had radical mastoidectomies. In this group, disturbances in taste nearly always were found after the radical operations. No taste changes were observed in the fenestrated patients. ROBERT LEWY, Chicago.

Larynx

CANCER OF THE LARYNX. CHEVALIER L. JACKSON, J. V. BLADY, C. M. NORRIS and W. H. MALONEY, J. A. M. A. **138**:1080 (Dec. 11) 1948.

The authors discuss the five year end results in a series of patients treated for cancer of the larynx between 1930 and 1947. At the Temple University Hospital 612 patients were treated, 453 of whom received partial or total laryngectomies and 159 received irradiation.

A breakdown of the results reveals that 371 operations or initial courses of treatment were given through December 1942, so that these are suitable for evaluation of five year end results. The results in 16 of the laryngofissures were indeterminate because of death from other cause within five years or failure of follow-up observation, leaving 102 (determinate) patients surviving more than five years. Of the 162 laryngectomies, the 123 done prior to 1940 were not performed by the authors, and 4 of the patients who had been operated on by them died of other cause or were lost to follow-up observation, leaving 35 operations in determinate cases (meaning those with death not of other causes within five years of treatment which were traced). Further analysis shows that 31 of these should be counted because 3 patients had been treated previously by laryngofissure and 1 by irradiation. Of the 91 patients treated initially by irradiation, the results in 8 were indeterminate and in 83 determinate. Adding these groups, 102 patients operated on by laryngofissure, 31 by laryngectomy and 83 by irradiation, it is noted that there were 216 determinate patients treated from 1930 to 1942 inclusive, with a survival rate of 72 per cent.

Analysis of the 19 recurrences in 102 laryngofissures showed that 74 per cent occurred in the first three years and that four (22 per cent) occurred after five years. It is suggested that three year statistics have some value and that five year statistics are by no means final.

With regard to laryngofissure, the initial cure rate of 81 per cent and the salvage of 51 per cent in the recurrences following this procedure has led the authors to insist on its value and to protest against the current tendency to disparage it. It is urged that its use be restricted to suitable cases.

Recurrence after laryngectomy has not been successfully treated in this series, but recurrences after irradiation have been salvaged by second courses of irradiation and laryngectomy.

Continued post-treatment observation for at least five years and preferably for life is advised in all cases. Prompt institution of intensive treatment, either surgical or radiative or both, is necessary in case of recurrence or metastasis if salvage of failures of initial treatment is to be secured.

Criteria for the selection of treatment should be constantly studied and reevaluated in the light of the end result analyses such as have been noted above, and, finally, the technic of treatment should likewise be reevaluated and modified according to experience.

ABSTRACT OF DISCUSSION

Dr. Gordon B. New, Rochester, Minn.: The surgeon must determine the original method of treatment and has an important decision to make. Microscopic examination of a fresh frozen specimen section is essential. The operative mortality in the treatment of carcinoma of the larynx has been reduced considerably by improvement in technic and the use of penicillin.

Dr. Paul Holinger, Chicago: The question of grading the tumors and the relation of the age of the patient to the incidence of recurrence might be enlightening.

Dr. Gabriel Tucker, Philadelphia: Dr. Gabriel reported a similar series of cases and emphasized the importance of adequate follow-up observation in all cases. Other conditions may arise in the larynx after a successful surgical removal of a malignant growth. One such interesting case is that in which a laryngofissure (thyrotomy) was performed about 15 years ago, after which the patient consulted the original referring physician, who, on examination, found a mass in the larynx. On removal, it was found, histologically, to be a fibroma.

Dr. Murdock Equen, Atlanta, Ga.: The rehabilitation of these patients so far as the voice is concerned ought not be forgotten. An excellent esophageal voice may be obtained by patients after intensive instruction and practice.

Dr. Chevalier L. Jackson, Philadelphia: Grading is taken into consideration in the borderline cases in making decisions between the various methods of treatment. Grading should not be ignored, though in his series he felt that it was one of the less important factors.

Dr. John V. Blady, Philadelphia: Cancer requires radical treatment. Physicians should not confine themselves to any one modality but should use such as observation and experience have proved best in any given diagnosis. Grading is important in determining the selection of one or other modality of treatment.

Gordon, Philadelphia.

Diagnosis and Treatment of Laryngeal Tumors. Daniel S. Cunning, J. A. M. A. **142**:73 (Jan. 14) 1950.

The author discusses in detail how to examine a larynx and states the opinion that "more is seen with the laryngeal mirror than with any type of laryngoscope."

The diagnosis and treatment of polypi, papilloma, vocal nodules, cysts, contact ulcer and cancer of the larynx are set forth in moderate detail. Biopsy and pathological examination must be performed on all tumors of the larynx.

The surgeon should determine the type of treatment in any given case, whether it be surgical or roentgenologic or both. The end results in five year cures with roentgen therapy of early cordal cancers are on a par with those of surgical intervention. Patients treated with roentgen rays can be watched every month; if there should be a recurrence, surgical procedures can be done at that time.

GORDON, Philadelphia.

THE EFFECT OF ORAL THERAPY WITH COBALTOUS CHLORIDE ON THE BLOOD OF PATIENTS SUFFERING WITH CHRONIC SUPPURATIVE INFECTION. JOSEPH C. ROBINSON; G. WATSON JAMES III and ROBERT M. KARK, New England J. Med. **240**:749 (May 12) 1949.

The authors had studied 91 young men who suffered from prolonged suppurative infection. Cobaltous chloride had been given by mouth, and the observers noted reticulocytosis followed by increases in hematocrit and hemoglobin values. Apparently cobalt stimulates red cell production in children as well as in adults and also protects animals from developing anemia when sterile suppuration is induced experimentally.

In this review 9 male patients, whose average age was 25 (the oldest being 30 and the youngest 18), were selected for study because they had all spent an average of 28 months in the hospital for chronic osteomyelitis or chronic soft tissue suppuration. At the onset of the disease and thereafter all patients had received adequate therapy with blood and blood substitutes and, in addition, had been treated with sulfonamide derivatives (usually sulfadiazine), penicillin and streptomycin. When first observed by the authors, all patients showed evidence of chronic sepsis, as judged by drainage of pus from wounds, pyuria, continued fever or radiographic evidence of bone sequestrums. There was no clinical evidence of vitamin or protein deficiences, although all patients had lost weight. The red cell sedimentation rate was increased, and in all cases cultures of organisms were obtained from sites of sepsis. The organisms were identified and were usually found to be resistant to penicillin or streptomycin. In these patients plasma iron levels were low and plasma copper levels were increased.

After the patients had been observed during the control period they were treated with 20 to 60 mg. of cobaltous chloride orally each day after meals. Treatment was continued for eleven weeks in four cases, for four weeks in a second group of four patients and for two weeks in one patient.

During this time none of the patients received transfusions or therapy with other hematopoietic agents. In all patients a reticulocytosis was observed within six days. This condition was followed by increases in red cell counts, in hemoglobin values, in hematocrit levels, in blood volume and in total circulating hemoglobin. The authors conclude, however, that the mechanism of cobalt activity in patients with chronic infection is still unexplained and requires further study.

GOODALE, Boston.

THE POSTLARYNGECTOMY CLINIC OF THE NATIONAL HOSPITAL FOR SPEECH DISORDERS: A STATISTICAL STUDY OF 300 PATIENTS. JAMES SONNETT GREENE, New York State J. Med. **49**:2398 (Oct. 15) 1949.

Dr. Greene is director of the National Hospital for Speech Disorders, in New York. He notes that the first recorded laryngectomy was performed in 1873 by

Billroth. The mortality rate subsequently was so high that laryngectomy was almost discontinued, until a few years ago when improvements in technics, both before, and during operation, made the mortality rate less than 1 per cent!

Then came the problem of what to do after complete healing. Many instruments were devised in an effort to recover speech, but they had too many objectionable features. Now it is known that swallowing of air and regurgitating it in a special manner may give understandable speech and better enable the person to earn a living.

Of 300 patients in this clinic, the ratio of male to female patients was 22 to 1. Two thirds were between the ages of 50 and 70, which points to the malignant condition of the larynx as being a disease of advancing years. Moreover, it is prevalent in the uneducated—three fifths were laborers or unskilled workers.

Response to education in the technic of swallowing and regurgitating air was variable. Some subjects acquired the trick easily; others never quite caught on. However, about 70 per cent went back to work or obtained a new job. "The return of such a large percentage of patients to useful lives is one of the major satisfactions in conducting a clinic of this type." Twelve tables show such data as incidence, diagnosis and relation to age and sex. The discussions by Dr. John D. Kernan and Dr. Girard F. Oberrender are of very special interest and are printed at the end of the article. I. W. Voorhees, New York.

Determination of the Method of Treatment of Cancer of the Larynx. Justo M. Alonso, Rev. Otorrhinolaring. **9**:131 (Dec.) 1949.

In cancer of the larynx, it is incumbent on the surgeon to determine the proper type of therapy, since there are two functions to be considered: (1) to save the life of the patient and (2) to save his voice, if possible. Certain types of cases are amenable to roentgen therapy, while other types require operation. Alonso has indicated the following routine: (1) Since the higher the lesion in the larynx, the more sensitive it is to irradiation, lesions above the vocal cords can be treated by roentgen therapy or by surgical procedure. However, fixation of the cord due to infiltration of the musculature, subglottic carcinoma or involvement of one of the ventricles does better when treated surgically. Cancer of the piriform sinuses and lateral walls of the pharynx do not respond to irradiation. (2) Exuberant tumors respond to irradiation, but the hard, ulcerative and infiltrative carcinomas, especially when they involve the cartilage and cause fixation of the muscles, should be removed surgically. (3) Undifferentiated tumors seem to respond best to roentgen therapy. (4) When there is metastasis to the lymph chain, best results are obtained by a combination of extensive neck block dissection plus irradiation. However, in every case the most conservative surgical treatment should be followed through, and whenever possible systematic total laryngectomy should be avoided. Persky, Philadelphia.

Pharynx

Sedimentation Rate in the Viggo-Schmidt Test. R. Coen, Valsalva **25**:126 (May-June) 1949.

The author, in consideration of the Viggo-Schmidt tonsillar test, supposed that after massage of a diseased tonsil, conceivably serving as a site of focal infection, there should be changes in the sedimentation rate as well as in the white blood count.

He has examined 60 patients, of whom 16 had chronic tonsillitis without manifestations of focal infection; 10, renal diseases; 10, cardiac disturbances, and 10, oropharyngeal involvement secondary to typhoid fever. There were 14 normal controls.

White blood count, differential count and sedimentation rate studies were made. Tonsil massage was then instituted. At the conclusion of the latter procedure, the aforementioned studies were repeated at intervals of 30 minutes, one, two, three and four hours after the tonsil massage. In the cases with evidence of focal infection a definite parallel was noted between the variations in the leukocyte count and differential and the variations in the sedimentation rate.

In the cases of chronic tonsillitis, some changes were observed, but they were not comparable in relevance to those noted, for instance, in the cases complicated by nephritis. In the control group neither test showed any changes whatsoever.

MELUCCI, Philadelphia.

Nose

DIAGNOSIS OF MALIGNANCY OF THE NASOPHARYNX: CYTOLOGICAL STUDIES BY THE SMEAR TECHNIQUE. LEWIS F. MORRISON, EUGENE S. HOPP, and ROSALIN WU, Ann. Otol., Rhin. & Laryng. **58**: 18 (March) 1949.

Early diagnosis of malignant conditions of the nasopharynx is vitally important, but the difficulty is great for several reasons. The initial lesion is usually small and usually causes no symptoms until metastases occur. The first symptoms frequently are referred to some other area, such as the neck, eye or ear, and the original site of trouble is not readily accessible for examination. Also, the variations in the appearance of the lymphoid tissue in the nasopharynx, which may be considered "within the limits of normal," are greater than in other areas of the upper respiratory tract.

It is difficult, too, to obtain satisfactory and representative biopsy material. Because of these difficulties, the use of the Papanicolaou and Traut technic in staining smears from the area holds promise of help, but a knowledge of the normal cytology of the area is essential, and the method is time-consuming and demands painstaking attention to detail.

An examination is first made of the ears, nose and throat; the nasal mucosa is shrunken and anesthetized, and the nasopharynx is examined with a nasopharyngoscope and posterior rhinoscope mirror. A cotton-tipped applicator is inserted through the nose and rubbed on the surface of the nasopharyngeal mucosa, coming in contact with as much of the surface as possible. The material obtained is transferred to a dry, clean slide and fixed at once in a solution of equal parts of 95 per cent ethyl alcohol and ethyl ether. The staining is done by the modified method of Papanicolaou and Traut with but one exception, in step 6, EA50 replaces EA36 or EA25.

Normal Findings.—The exfoliated cells will all be adult, and many will show evidence of lytic or autolytic changes. In general, the cells are larger than the same type of cell when it is functional and in its relatively crowded normal surroundings.

One finds ciliated columnar cells, and some which have lost their cilia, lymphocytes, polymorphonuclear leukocytes and occasional clasmatocytes or tissue macrophages. These macrophages can easily be confused with malignant cells due to their characteristic variation in size and shape. In addition, one commonly

finds squamous epithelial cells, bacteria and erythrocytes. The cytoplasm of the normal columnar cell is usually clear, but one variation is the foamy or globular cytoplasm encountered normally during the secreting phase of the goblet cell. The nuclei vary in size, shape and position in the cell, are relatively large and oval and contain distinct nucleoli. The chromatin is evenly distributed or finely granular, and the nuclear wall is distinct but not thickened or irregular.

Malignant Findings.—The cell nucleus rather than the cytoplasm presents the characteristics which permit the cell to be classified as malignant. An enlarged nucleus and nucleolus with abnormal chromatin content are significant. The eccentric position of the chromatin simulated a thickened nuclear membrane. The enlarged nucleoli may appear eosinophilic and are frequently surrounded by a small amount of cytoplasm. The cell wall is often distorted, indistinct or absent. The presence of clumps of these cells is most significant.

The authors report on the results of their examination of patients by this method and believe that in the hands of those who have the proper knowledge of the normal cytology of the area and the willingness to be painstaking in their attention to the detail of the technic the method of diagnosis is very useful, but it has nothing to offer the casual observer. MILLER, Philadelphia.

THE CORRECTION OF DEFORMITIES OF THE NOSE ASSOCIATED WITH NASAL OBSTRUCTION. JAY D. WHITHAM, New York State J. Med. **49**:2413 (Oct. 15) 1949.

From the author's clinic at the New York Eye and Ear Infirmary, certain deductions are made concerning a very common form of plastic surgery, namely, correction of nasal deformities. Trauma is the commonest cause of these deformities. It often occurs in infancy, and not much attention is paid to it until adolescence. After operation, failure is often due to neglecting to remove the bone anteriorly along the floor of the nose. Whitham performs the septum operation, allows it to heal and then does the plastic work later. One must refracture the nose so that the original condition is reproduced. From then on the way is fairly clear. Correction at the time of injury is ideal, but is seldom done effectively if at all.

The cardinal rules are to separate all soft parts freely from bone, free the columella by incision at the point of the nasal process and turn it up out of the way. The submucous work is thus made easier. The nasal spine should be removed by chisel. If both submucous and subcutaneous operations are done at the same sitting, overcorrection of the external nose is advisable for a few days. Then a Joseph splint is applied for a short time, and when the splint is removed the nose will be straight. The columnar cartilages must be freed at the septal junction. When the septal cartilage has been split into layers it is good practice to preserve one layer for future support of the anterior part of the nose. The columella exposure gives excellent access to the septal deformity. The columella is carefully sutured into place at the end of the operation.

I. W. VOORHEES, New York.

Miscellaneous

CONGENITAL ANOMALIES OF THE ESOPHAGUS RELATED TO ESOPHAGEAL FOREIGN BODIES. PAUL H. HOLINGER, KENNETH C. JOHNSTON and JOSEPH GREENGARD, Am. J. Dis. Child. **78**: 467 (Oct.) 1949.

Congenital lesions of the esophagus are of especial interest, now that esophagoscopy and operation may effect a cure. The symptoms are slowly progressive dysphagia, foreign body signs and/or complete esophageal obstruction. Three

types are to be recognized: (1) congenitally short esophagus; (2) congenital esophageal stenosis and (3) stricture of the esophagus. The latter condition may follow efforts at repair. The first and second condition present no symptoms during the first five months of life. Later, when semisolids and solids are taken, swallowing becomes increasingly difficult. A congenitally short esophagus is almost invariably associated with narrowing at the cardia. It is notable that a congenitally short esophagus has an entirely different appearance from a strictured esophagus.

Anatomic locations are given, but of 604 cases, the condition in 436 or 73 per cent, was located in the cervical region of the esophagus. The location in the others varied. Any particle of food (or foreign body) is passed easily by the strong muscles of the pharnyx to the cervical isthmus. There, the weaker muscles of the esophagus cannot propel the particle further, or if they do it is done only under great disadvantage.

One should not be content with merely removing the foreign body, for both fluoroscopic and roentgenographic studies may show the stricture. It may be possible to dilate the stricture by direct vision, or, in severe cases, thoracic surgery may be necessary. Six case reports from the Children's Memorial Hospital, St. Luke's Hospital and the Illinois College of Medicine afford the data from which the authors' conclusions are derived.

I. W. VOORHEES, New York.

THYROGLOSSAL CYSTS AND SINUSES. SAMUEL F. MARCHALL and WALTER F. BECKER. Ann. Surg. **129**:642 (May) 1949.

Thyroglossal cysts, sinuses or fistulas constitute one of the commonest congenital anomalies arising in the neck. They occur in the midline of the neck at any level from the base of the tongue downward to the suprasternal notch. Cysts are found more commonly below the hyoid bone than above it. Successful treatment of this condition is dependent on complete removal of the entire thyroglossal tract, which must include excision of the central part of the hyoid bone and the tract extending above the hyoid to the cecal foramen.

BANTIN, Omaha [AM. J. DIS. CHILD.].

TRENDS IN OTOLARYNGOLOGY. HENRY B. ORTON, J. A. M. A. **141**: 749 (Nov. 12) 1949.

Dr. Orton reviews the opinions of Canfield, Mosher, Richards and Furstenberg, emphasizing the need of training of otolaryngologists for treatment of parts of the body contiguous with the ear, nose and throat.

Otolaryngologists are better suited to operate in these parts because they are trained in working in small fields and have developed monocular vision.

They should be trained in surgical principles and have a thorough grasp of preoperative and postoperative measures, of fluid balance and protein replacements, metabolism and the treatment of shock, of systemic complicating factors, organic disease and physiologic considerations of thoracic surgery and the surgery of neoplasms of the head, neck and salivary glands.

With 18 per cent of all malignant growths in the body above the clavicle, the otolaryngologist should be qualified to perform surgical procedures in that field by reason of being more familiar with that area.

The future of this specialty is a glowing one, but the otolaryngologists should expand the field and not allow it to be more and more restricted.

"Let us break the bonds of narrow satisfaction and courageously attack our responsibilities with foresight, to become broader medical men and better surgeons."

GORDON, Philadelphia.

THE PROBLEM OF MALPRACTICE. LOUIS J. REGAN, J. A. M. A. **141**:774 (Nov. 12) 1949.

The author, a physician as well as an attorney, has written a revealing article in which he discusses physician-patient relationship and presents extracts from malpractice cases, stressing the fact that the doctrine of *res ipsa loquitur* is of increasing importance in the law of malpractice. He lists 23 points pertaining to the prevention of malpractice suits, the essence and outline of which are as follows.

The physician should care for every patient with scrupulous attention. He must know his legal duty to the patient and must avoid destructive and unethical criticism of the work of other physicians. Accurate medical records should be kept with all details so that they would meet the standards required by the law. The physician should never make any statement that might be construed as an admission of fault on his part. His relations with the patient and the patient's family should be friendly and never strained, and if a feeling exists that a consultation is necessary he should at once suggest it.

He should refrain from overoptimistic prognoses and should advise his patients of any intended absence from practice, recommending or making available a qualified substitute. He should unfailingly secure written consent for operation and for autopsy. There should be careful supervision of assistants. The Statute of Limitations should be understood. The physician should limit himself to such fields as he is qualified in and should keep inviolate all confidential communications.

He should check his equipment; never experiment in the treatment of his patient; always render care in the entire management of the given case; never abandon the patient; never reveal that he carries professional liability insurance, and always arrive at an understanding in the matter of fees, particularly when the question of excessive fees arises. The physician should always secure legal advice if he is called to attend a coroner's inquest as a witness in a case in which he has been in professional attendance.

He should avoid telephoning a prescription lest error occur in transmission. Finally, he should exercise due caution in clearly advising just what operation he feels is indicated so that neither the patient nor his family will misunderstand, thus giving them no cause to file a malpractice suit. GORDON, Philadelphia.

TRIMETON, A NEW ANTIHISTAMINIC DRUG. I. W. SCHILLER and F. C. LOWELL, New England J. Med. **240**: 215 (Feb. 10) 1949.

Trimeton® (1-phenyl-1-[2-pyridyl]-3-dimethylaminopropane) has been shown in animal experiments to possess a high degree of antihistaminic activity and low toxicity. The authors used it for 84 patients with hay fever, urticaria and perennial allergic rhinitis.

Because of the favorable therapeutic response, the drug gives promise of being a valuable addition in histamine-antagonizing compounds. It is particularly effective in the symptomatic treatment of perennial allergic rhinitis. Side reactions occurring in only 10 of the 84 cases were mild and consisted solely of dryness of the mouth and drowsiness. Side reactions such as nervousness, restlessness, nausea and dizziness found with the use of some of the other antihistamines were notably absent. GOODALE, Boston.

A Study of Acute Intracranial Complications Treated with Antibiotics Having Either an Apparent or Latent Focus of Otorhinologic Etiology. Arturo Tello T., Rev. otorrinolaring. **X**:1 (March) 1950.

Since the advent of the antibiotics the clinical picture of intracranial complications has changed considerably. Many foci of infection in the middle ear and paranasal sinuses have become obscured, yet the number of complications still occur. At the time of their occurrence the pathologic aspect of both the middle ear and the paranasal sinuses has been so altered that the surgeon has considerable doubt as to the source of the intracranial complication. The antibiotics alone are not the only obscuring or masking factor. A number of intracranial complications are due to the pneumococcic organism, which in itself has a tendency to produce atypical findings. Tello discusses the symptomatology and diagnosis in 31 cases of intracranial complications. The exact diagnosis in his cases have at times been very difficult. The source of the original focus is extremely important, since if this is not irradicated surgically the intracranial complication does not yield to treatment. He has divided his cases into two groups; in the first series, if he did not find frank evidence of pathologic change in the middle ear or paranasal sinuses, he treated the complication symptomatically and he obtained a mortality rate of 59 per cent. In the second series, he decided that it was best not to wait or depend on frank pathologic conditions in the middle ear or sinuses but rather to do an early exploration of these foci. In many cases he found a latent disease which was directly responsible for the intracranial complication. In consequence, his mortality rate in the second series was reduced to 25 per cent. In conclusion, he states that (1) a manifest focal (either in the middle ear or paranasal sinus) pathologic process should not be expected, since this is often obscured or masked by modern chemotherapy; (2) if the focus of infection is suspected in the presence of the intracranial complication, every effort should be made to localize this, and (3) the sooner this focus is removed the more favorable the prognosis.

Persky, Philadelphia.

The Respiratory Epithelium as a Vital Organ and Some Pathological Changes in It Due to Common Diseases. A. C. Hilding, Acta otolaryng. **37**:1 (April) 1949.

The author states that the respiratory epithelium of the nose, the trachea and the bronchi has a specific function. This function is vital. The importance of this epithelium is not generally realized, and if the epithelium is deranged there may be very serious consequences. In general, the nose cleanses, warms or cools and humidifies the inspired air to proper levels. When and if the nose fails to do so, the epithelium of the bronchi is capable of this function. Hilding asserts that the mechanism of atelectasis is one of a vacuum set up by a combination of excess secretion and very strong ciliary action. A similar action is probably responsible for the development of "vacuum headache" in the paranasal sinuses.

In asthma, when the patient dies of asphyxia, it is due to a loss of ciliary action plus the formation of a mucinous cast continuous with the stretched goblet cell structure, which is so extensive as to prevent coughing and other action from removing it. Some viruses, such as those of influenza and the common cold, seem to prefer respiratory epithelium. In these attacks surface cells and their cilia are lost. If this loss is great enough, secretions may accumulate until asphyxial drowning occurs. Thin, watery secretions are more poorly handled than thicker secretions.

Robert Lewy, Chicago.

Book Reviews

The Nose: An Experimental Study of Reactions Within the Nose in Human Subjects During Varying Life Experiences. By T. H. Holmes, M.D., Hofheimer Research Fellow in Medicine; H. Goddell, B.S., Research Fellow in Medicine; S. Wolf, M.D., Assoc. Prof. of Medicine, and H. G. Wolff, M.D., Prof. of Medicine (Neurology), Cornell University Medical College. Foreword by W. T. Longcope, M.D. Price, $4.50. Pp. 172, with 35 figures (5 illustrations in color). Charles C Thomas, Publisher, 301-327 E. Lawrence Ave., Springfield, Ill., 1950.

Although none of the authors of this little book is an otolaryngologist, the data presented should certainly be of interest to all otolaryngologists. The purpose of this monograph has been set forth in the preface of the text, and the authors are to be commended for the fine presentation of the psychosomatic aspects of the specialty.

The contents of the book are presented in the following sequence: review of nasal physiology; range of nasal functions in normal subjects; alterations in nasal function following specific and general threats to respiratory apparatus and bodily integrity; relationship of nasal changes to disturbances involving the eyes and deeper respiratory structures; personality and background of an intensively studied subject; relation of nasal to sexual and gastric function; mechanisms involved in disorders of the nasal spaces; pain from paranasal structures, "sinus headaches"; considerations and formulation, and summary. At the end of the chapters is a complete bibliography.

This book, which should be of interest to all physicians, highlights the proposition that the practice of otolaryngology is a medical as well as a surgical specialty and that the whole must be considered along with the part, the past along with the present.

Carcinoma of the Larynx. By F. Baclesse, M.D., Chief of Service of the Roentgen Ray Department, Foundation Curie, Paris. Price, 25s. Pp. 68, with 97 figures. British Institute of Radiology and The Röntgen Society, 32 Welbeck St., London, W.1, 1949.

This supplement, no. 3 of the British Journal of Radiology, contains the paper delivered at the meeting of the British Institute of Radiology, held in London in 1947, and a paper entitled "A Statistical Report on Cases Treated with X Rays Only," by R. W. Gunderson, of the Meyerstein Institute of Radiotherapy.

This monograph fulfils the two fold purpose for which it was conceived, namely, to show the importance of clinical and radiological examination with respect to prognosis and interpretation of results and to discuss the various methods of roentgen ray therapy of the larynx in the light of the five year survival figures.

The material is presented in ten large sections: classification of laryngeal cancers; cancer of the vestibule; cancer of the true cord; subglottic cancer; laryngoscopic views of various lesions; radiographic pictures; histology; statistics; roentgen therapy and physical factors in technic.

This booklet should be of interest to all otolaryngologists and radiotherapists, who may easily overlook the insignificant tendency of the author to speak of glands in referring to lymph nodes. All in all, the book may be useful in the control of cancer because of the viewpoints it presents.

Diseases of the Eye, Ear, Nose and Throat: A Textbook for Nurses. By Albert P. Seltzer, M.D., Sc.D. (Med.), F.I.C.S., Assistant Professor in Otolaryngology, Graduate School of Medicine, University of Pennsylvania, and Instructor of Nurses at St. Luke's and Children's Medical Center. With the technical assistance of Bernard C. Gettes, M.D., Instructor of Ophthalmology, Graduate School of Medicine, University of Pennsylvania, and Instructor of Nurses in Ophthalmology, Wills Hospital, Philadelphia. First Edition. Price, $4. Pp. 347, with 28 figures. McGraw-Hill Book Company, Inc., 330 W. 42nd St., New York, 1950.

This book is one in the publisher's series on nursing. For a long time there has been a need for a textbook such as the author has presented. The purpose of the book is to offer, in a coordinated manner, all the essential information about disorders of the eye, ear, nose and throat which falls within the scope of the nursing profession. The book is so written that it reflects the author's experience in the teaching of nurses. For the undergraduate nurse, the subject has been adequately simplified. For the graduate nurse, however, one preparing to assist the specialist, some aspects will appear too abbreviated and, on critical review, misleading or even occasionally inaccurate.

The contents of the book, following a short preface and introduction, are arranged in eight sections: general considerations, the eye, the nose, the mouth, the throat and the esophagus, the larynx and the trachea, the ear and special subjects. A list of visual aids and an index complete the book.

The section devoted to the eye, which has been written with the able assistance of collaborators of the senior author, should be positively noted.

A History of Otolaryngology. By R. Scott Stevenson, M.D., F.R.C.S. (Ed.), and Douglas Guthrie, M.D., F.R.C.S. (Ed.). Price, $5. Pp. 155, with 52 illustrations. Williams & Wilkins Company, Mount Royal and Guilford Aves., Baltimore, 1949.

This history of the specialty of otolaryngology had for its stimulus the recent International Congress of Otolaryngology. What started out to be an independent enterprise of each author has been blended into a fine little book, in which the field of otolaryngology is discussed in a readable manner. The titles of the chapters are Introduction; Ancient History; The Middle Ages and the Renaissance; The Seventeenth and Eighteenth Centuries; Otology Becomes a Science; The Education of the Deaf; Laryngology in the Nineteenth Century, and Modern History. There is both a bibliography and an index. The development of the specialty and the available literature and the progress in the field from the earliest times to the present are covered. This readable book should be of interest to all otolaryngologists.

CORRECTION

Following is a correction of the last paragraph of Dr. David Davis' discussion of the paper by Dr. John R. Simpson, "Management of Acute Laryngotracheobronchitis," which appeared in the December issue of the ARCHIVES, page 724.

"Another thing I do, which is probably very unorthodox and which has been criticized, is use an oil in the bronchi. I use Lilly's inhalant no. 31, a refined peanut or sesame oil, containing ephedrine and sodium ethylmercurithiosalicylate (merthiolate®), which is sold as nosedrops. I dip the end of the rubber

catheter into this oil before aspirating through the tracheotomy tube, and I am still surprised to see how much further the tube goes with the oil and how easily it slips down the tracheobronchial tree. Often, the suction catheter will bring out some crusts, which would probably cause atelectasis or even death if they were allowed to remain in the bronchi. I even instill a few drops of this oil through the tracheotomy tube and, after a few seconds, aspirate the excess. This procedure is the same as that used with a saline or sodium bicarbonate solution, but I find the oil much superior. I have never had any difficulty from the use of this oil. It is comparable to iodized oil U. S. P. (lipiodol®), but the quantity needed is so much less, merely a few drops being enough. Since using this oil, I have not had to insert a bronchoscope to remove any crusts—the oil softens the crusts and they are removed without difficulty with the suction catheter. It has saved my time and, I believe, has occasionally saved a life, since before I used this oil I was called at times in the middle of the night to rush to the hospital to remove a crust through the bronchoscope that could not be removed by catheter suction. Now, with use of the oil, the nurses get the crusts out with the rubber catheter without difficulty. These crusts will form in some patients in spite of all the steam that is used, and they have to be removed. I daresay that with the use of the proper antibiotics the formation of these crusts will be inhibited and even the necessity for tracheotomy will be eliminated in many cases."

Directory of Otolaryngological Societies *

NATIONAL

American Medical Association, Scientific Assembly, Section on Laryngology, Otology and Rhinology

Chairman: Dr. J. Milton Robb, 1553 Woodward Ave., Detroit 26.
Secretary: Dr. Sam H. Sanders, 1089 Madison Ave., Memphis 3, Tenn.
Place: Atlantic City, N. J. Time: June 13-15, 1951.

American Academy of Ophthalmology and Otolaryngology

President: Dr. J. Mackenzie Brown, 1136 W. 6th St., Los Angeles 14.
Executive Secretary-Treasurer: Dr. William L. Benedict, 100-1st Ave. Bldg., Rochester, Minn.
Place: Palmer House, Chicago. Time: Oct. 8-13, 1950.

American Board of Otolaryngology

Secretary: Dr. Dean M. Lierle, University Hospitals, Iowa City.
Place: Hotel Biltmore, New York. Time: Jan. 8-11, 1951.
The Roanoke Hotel, Richmond, Va. Time: May 1-4, 1951.

American Broncho-Esophagological Association

President: Dr. Chevalier L. Jackson, 3401 N. Broad St., Philadelphia 40.
Secretary: Dr. Edwin N. Broyles, 1100 N. Charles St., Baltimore 1.
Place: White Sulphur Springs, W. Va. Time: May 7 and 8, 1951 (p. m.).

American Laryngological Association

President: Dr. Gordon B. New, 102 2nd Ave., S. W., Rochester, Minn.
Secretary: Dr. Louis H. Clerf, 128 So. 10th St., Philadelphia 7.
Place: White Sulphur Springs, West Virginia. Time: May 9-10, 1951.

American Laryngological, Rhinological and Otological Society, Inc.

President: Dr. Louis H. Clerf, 128 So. 10th St., Philadelphia 7.
Secretary: Dr. C. Stewart Nash, 708 Medical Arts Bldg., Rochester 7, N. Y.
Place: White Sulphur Springs, W. Va. Time: May 6-8, 1951 (a. m.).

SECTIONS:

Eastern.—Chairman: Dr. Harry P. Schenck, 326 So. 19th St., Philadelphia 3.
Place: Philadelphia. Time: Jan. 12, 1951.
Southern.—Chairman: Dr. Charles C. Grace, 145 King St., St. Augustine, Fla.
Place: Miami, Fla. Time: Jan. 17, 1951.
Middle.—Chairman: Dr. Clarence W. Engler, 2323 Prospect Ave., Cleveland.
Place: Cleveland. Time: Jan. 15, 1951.
Western.—Chairman: Dr. Lewis F. Morrison, 490 Post St., San Francisco.
Place: San Francisco. Time: Jan. 27-28, 1951.

American Otological Society

President: Dr. Kenneth M. Day, 121 University Place, Pittsburgh.
Secretary: Dr. John R. Lindsay, 950 E. 59th St., Chicago.
Place: White Sulphur Springs, W. Va. Time: May 11-12, 1951.

American Otorhinologic Society for the Advancement of Plastic and Reconstructive Surgery, Inc.

President: Dr. Bert E. Ellis, 25 East Ohio St., Indianapolis 4.
Secretary: Dr. Joseph G. Gilbert, 111 E. 61st St., New York 21.
Place: Palmer House, Chicago. Time: Oct. 12, 1950.

American Society of Ophthalmologic and Otolaryngologic Allergy

President: Dr. George E. Shambaugh Jr., 55 E. Washington St., Chicago.
Secretary-Treasurer: Dr. Joseph Hampsey, 806 May Bldg., Pittsburgh 22.

* Secretaries of societies are requested to furnish the information necessary to keep this list up to date.

...*Radiographs* without Delay with a RITTER Shockproof X-Ray

YOUR patients appreciate receiving treatment that is complete yet takes minimum time. With a Ritter Shockproof X-ray installed in your office, you are able to take radiographs easily and rapidly. You save your patients the inconvenience of referral. Their confidence in your skill is increased when you complete diagnosis and treatment in your own office.

The Ritter X-ray is easily operated with finger-tip positioning of the x-ray head. Proper angulation is quickly predetermined by calibrated scales. In fact, operation is so easy that your nurse can accurately operate its simplified controls with only a few hours of instruction.

For rapid, convenient radiographic diagnosis, the Ritter Shockproof X-ray will save you time and increase your income.

Visit your surgical dealer for a demonstration. Ask him for a copy of "Two Important Years"—a study of x-ray in ENT practice.

A RITTER SURGICAL CUSPIDOR, completely redesigned, provides greater efficiency at low water pressure. More effective vacuum control maintained with a finger-tip regulator at the aspirator handle. Use any aspirator tip. This modern equipment is a necessity in every doctor's office.

FOR ADVANCED EQUIPMENT LOOK TO **Ritter**

COMPANY INCORPORATED
RITTER PARK, ROCHESTER 3, N.Y.

You're the Tobacco Expert we seek to please!

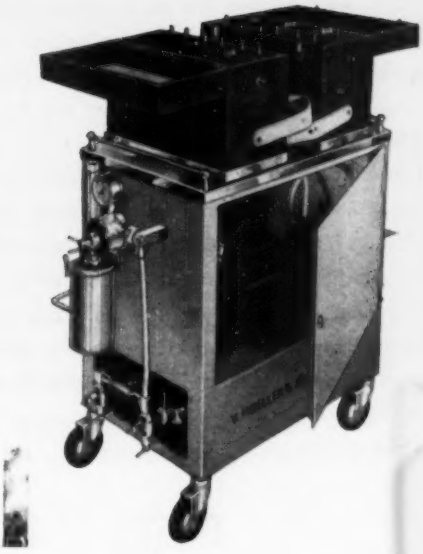
AFTER ALL—who smokes that Old Gold of yours? *You*, isn't it? Well—that's exactly why we work to please just *you*. That's why we cure just one thing—the world's best tobacco. For nearly 200 years we've been tobacco men, not medicine men. So we're sure that whenever you light up your Old Gold you'll agree . . . there's no more deep-down smoking pleasure in a world of smokes than that Old Gold!

For a Treat instead of a Treatment
...treat yourself to **OLD GOLDS**

Holinger-Andrews

NEW BRONCHOSCOPIC UNIT

Combines All Five
Essential Requirements in One
Efficient, Compact Unit



Eliminates need for several pieces of equipment about the operating table . . . provides ample vacuum (twin pumps, two quart-size suction bottles), controlled oxygen, battery boxes, handy table surface for battery boxes, and an auxiliary electrical outlet . . . all within easy reach of the operator. Efficient double yolk oxygen assembly permits instant changeover of cylinders, includes improved humidifier, two-stage regulator, pressure gauge, flowmeter. Sturdy steel cabinet on 4-inch swivel wheels has stainless top shelf, bottle shelf, rails and trim.

WRITE for Complete Details TODAY

Instrument Makers To The Profession

V. Mueller and Company 408 S. HONORE STREET, CHICAGO 12, ILL.

In acute and chronic

Sinusitis

By using the NICHOLS NASAL SYPHON, these cavities may be safely and successfully drained of mucopurulent material, thus affording prompt symptomatic relief. Used and prescribed for more than 32 years. Prove its effectiveness on your most troublesome cases. Just mail the coupon.

Nichols **NASAL SYPHON**

NICHOLS NASAL SYPHON, INC. MONTCLAIR, N. J.

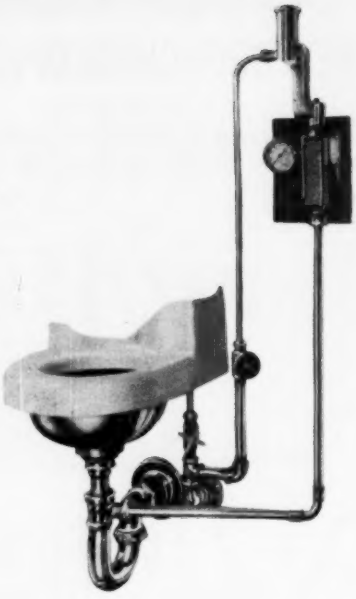
Please send details of SPECIAL OFFER "S" without obligation.

NAME..... M.D.

ADDRESS.....

CITY..... ZONE..... STATE.....

The **SMR Suction** has no moving parts, belts to break, valves to wear out, or motors to burn out. Once installed there is no cost of maintenance. Some local installations have been in constant use for over 20 years without attention other than changing the rubber tubing. If necessary, the secretions can be trapped, but in practice the secretions are drawn directly into the sewer. The **SMR SUCTION** can be attached to any lavatory which has an exposed trap and can be removed when changing offices. Complete with vacuum breaker, valve, tubing, trap tee and gauge (calibrated in mm. Hg.). Should have at least 20 pounds of sustained water pressure. Price $32.50 f.o.b. Los Angeles.



SMR

Surgical Mechanical Research

1901-1903 Beverly Blvd. Los Angeles 4, Calif.

For a Better Understanding of Nervous and Mental Diseases

Archives of Neurology and Psychiatry gives practical assistance to those readers who would keep well informed about the rapid progress in these fields. It presents original articles, clinical notes, special articles, society transactions and book reviews and book notices. Each issue includes a large number of brief digests from current medical literature which present significant findings of eminent neurologists and psychiatrists throughout the world. Well illustrated. Issued monthly. Averages about 2730 pages annually. Price, $12.00 a year. Canada, $12.40. Foreign, $13.50.

AMERICAN MEDICAL ASSOCIATION **535 North Dearborn Street, Chicago 10**

INSTRUMENT HOLDER

HARRY NEIVERT, M.D., and LEO A. KALLEN, M.D.

OVERALL DIMENSIONS
7" LONG
3" WIDE

This instrument-holder was designed for use by rhinoplastic and ophthalmic surgeons to prevent dropping of instruments which are usually left on the patient's chest. It provides:

1. ANCHORAGE OF INSTRUMENTS.
2. ORDERLINESS AND QUICK ACCESSABILITY.
3. ECONOMY OF SPACE, TIME AND ASSISTANCE.

The illustration shows an adjustable coil of wire, attached at each end to p sts which are secured to a curved base-plate. The coil is prevented from lateral or upward displacement by a strip of metal running thru its base. It is attached to the draping over the patient's chest by means of safety-pins as illustrated; or 2 towel clips may be clamped in alternate corners. Attached to one post is a simple device which makes it possible to adjust the space between turns of coil to fit thin instruments.
The entire outfit is made of stainless steel, rigid yet light in weight. For use on instrument table, a heavy flat-base model is procurable.

S. G. KREBS CO.

351 SECOND AVE., Cor. 20th ST., NEW YORK 10, N.Y. TEL. GR. 5-0585

The TWIN MIRROR GOOD-LITE

(The Physicians Universal Headlight)

* PEEP HOLE MIRROR—Center of beam light for deep cavities
* PLAIN MIRROR—For shallow cavities
(Both adjustable to parallel, convergent or Divergent rays)
* DIRECT LIGHT—For surface Surgery, by simply removing the mirror

Ultra Brilliant (750 foot candles), Large field of light, Glare free vision, shock proof molded rubber connections, Long Life bulbs, Original Parallel Ray headlight.

Sold by all leading Surgical Supply Houses

BETTER LIGHT MEANS BETTER SURGERY

THE GOOD-LITE COMPANY

7638 Madison St. Forest Park, Ill.

ISO-PAR

(Coparaffinate)

OINTMENT

Contains 17% Iso-Par (14 parts Iso-Paraffinic Acids, C_8-C_{18}, Av. Mol. Wt. 174, modified by 3 parts Mixed Amine Salts, principally 2-Hydroxy-5-Iso-Octyl-N, N-Dimethyl Benzylamine Salts of Iso-Paraffinic Acids, i. e., Iso-Octyl-Hydroxy-Benzyl-Dimethyl-Ammonium-Iso-Paraffinate), Cetyl Alcohol, Beeswax, Titanium Dioxide, Lanolin, Petrolatum, Essential Oils.

indicated in

OTITIS EXTERNA

Specific in Otomycosis. Highly effective in multiple infections. The advantages of symptomatic relief and absence of irritation throughout treatments are notable, also.

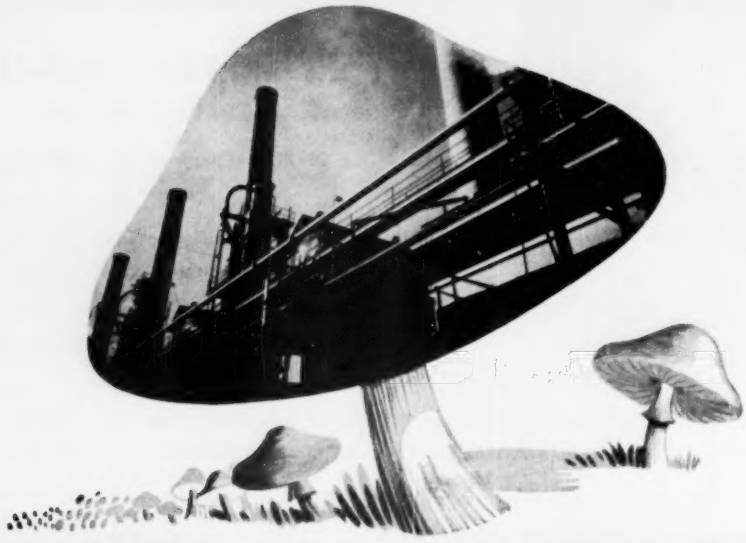
FUNGICIDAL
BACTERICIDAL

ANTIPRURITIC
STIMULATING

WALKER, J. S., BULLETIN OF THE JOHNS HOPKINS HOSPITAL, SEPTEMBER 1948: 225-228
REARDON, W. T., ARCHIVES OF OTOLARYNGOLOGY, MARCH 1947: 294-297

Available at pharmacies. Supplied in 1 lb., ½ lb., 1 oz. and ½ oz. jars. Samples upon request

Medical Chemicals, Inc., 406 E. Water St., Baltimore 2, Md.



VALUABLE IN YOUR PRACTICE

A monthly chronicle of medicine's rapidly growing role in industry!

THE NEW Archives of INDUSTRIAL HYGIENE and OCCUPATIONAL MEDICINE

Edited by: Men of outstanding reputation in the fields of industrial health and preventive industrial hygiene.

Prof. Philip Drinker, Boston, Chief Editor
Robert Kehoe, M.D., Cincinnati; James Sterner, M.D., Rochester, N. Y.; Frank Patty, Detroit, Mich.; Theodore Hatch, Pittsburgh; Frank Princi, M.D., Denver; Fenn E. Poole, M.D., Glendale, Calif.; William A. Sawyer, Rochester, N. Y.

Covering the RESEARCH AND FIELD ASPECTS of industrial hygiene and the CLINICAL AND MEDICAL ASPECTS of occupational industrial health programs.

MERGING the best features of Occupational Medicine and The Journal of Industrial Hygiene and Toxicology.

Integrated closely with the activities of the Council of Industrial Health of the A. M. A. and the American Industrial Hygiene Association.

DIRECTLY OR INDIRECTLY, much of today's medical practice touches upon industry—servicing industrial firms, attending employees, applying to general practice some of the findings of industrial medicine. The comprehensive new ARCHIVES of INDUSTRIAL HYGIENE and OCCUPATIONAL MEDICINE will bring reports of these important developments regularly to hand, with original articles delving into the problems and day to day experiences of the physician in industry; an excellent abstracting service similar to the section carried in the Journal of Industrial Hygiene and Toxicology; additional foreign journal abstracting, by special arrangement; reviews of current books and reviews of current literature.

From the first issue this better and more useful journal of industrial medicine promises to be "must" reading for well informed physicians.

AMERICAN MEDICAL ASSOCIATION
535 N. Dearborn, Chicago 10

Start my subscription to ARCHIVES of INDUSTRIAL HYGIENE and OCCUPATIONAL MEDICINE with *the next issue*. Per year, $8.00 (Canadian, $8.40; Foreign, $9.00)

I enclose check..... Please bill me .....

Name .....

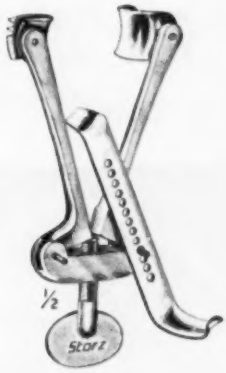
Address .....

storz
Surgical Instruments

New! Endaural Retractor For Lempert Fenestration Operation

1717 Retractor, Endaural, new T model: without temporal blade. Stainless.....$28.50

1718 Retractor, Endaural, new T model: complete with temporal blade. Stainless.$32.50



1718

Stainless Steel

Storz Instrument Company
4570 Audubon Avenue St. Louis 10, Missouri

Better exposure, less trauma –with the McIvor Mouth Gag

The usual hazards of trauma to the incisor teeth are eliminated by using this safe, simple instrument

Contact is placed behind the canine teeth. Fits any mouth from small child to adult . . . may be used on edentulous patients. Easily adjusted from side to side, always with two-point contact. Three sizes of tongue blades are provided. The contact portion of the ring is carefully covered with fine rubber tubing for the patient's protection and comfort.

THE McIVOR MOUTH GAG, of finest material and workmanship, with three tongue blades . . . . . COMPLETE **$25.00**

ORDER your McIvor Mouth Gag now! Write to...

THE ATRAUMATIC COMPANY 416 Thirtieth Street · OAKLAND 9, CALIFORNIA

SIMPLE TEST PROVES *INSTANTLY*
PHILIP MORRIS ARE LESS IRRITATING

*Now you can confirm for yourself, Doctor, the results of the published studies**

HERE IS ALL YOU DO:

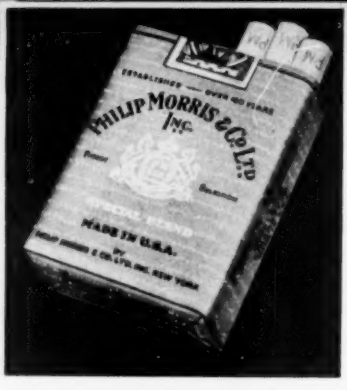
1 . . . light up a **PHILIP MORRIS**

Take a puff – DON'T INHALE. Just s-l-o-w-l-y let the smoke come through your nose. AND NOW

2 . . . light up your present brand

DON'T INHALE. Just take a puff and s-l-o-w-l-y let the smoke come through your nose. Notice that bite, that sting? Quite a difference from PHILIP MORRIS!

With proof so conclusive . . . with your own *personal experience* added to the published studies* . . . would it not be good practice to suggest PHILIP MORRIS to your patients who smoke?



PHILIP MORRIS

Philip Morris & Co., Ltd., Inc., 100 Park Avenue, New York 17, N. Y.

Proc. Soc. Exp. Biol. and Med., 1934, 32, 241-245; N. Y. State Journ. Med., Vol. 35, 6-1-35, No. 11, 590-592; Laryngoscope, Feb. 1935, Vol. XLV, No. 2, 149-154; Laryngoscope, Jan. 1937, Vol. XLVII, No. 1, 58-60

diagnostic triple-threat the world's largest selling ophthalmoscope, and the world's largest selling otoscope fitted in a case that's truly sanitary and amazingly durable . . . that's the new . . .

WELCH ALLYN diagnostic set No. 983 in the sandura case

Set includes Welch Allyn's finest — the No. 110 Ophthalmoscope with standard, pin hole and slit apertures, "white line" grid and red-free filter; and the No. 216 Operating Otoscope, with rotatable speculum holder and nylon specula in five sizes. The Sandura case may be sterilized inside and out, is more compact and longer lasting than old style cases.

WELCH ALLYN, Inc. **Auburn, New York**

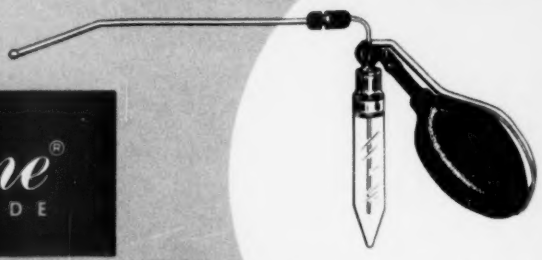
Safe, effective surface anesthesia

FOR BRONCHOSCOPY AND BRONCHOGRAPHY

ONLY 20 MILLIGRAMS OF PONTOCAINE HYDROCHLORIDE

will produce excellent surface anesthesia for bronchoscopy and bronchography. This has been clearly demonstrated in 167 consecutive unselected cases by Dr. A. Carabelli.[1] By means of a simple "one-hand" micro-atomizer and mirror-cannula — now available[2] — 8 cc. or less of 0.25 per cent Pontocaine hydrochloride solution will satisfactorily anesthetize the mouth, pharynx, larynx, trachea, and bronchi. For detailed technic, read original article or *write for our brochure.*

only 20 mg.



Pontocaine® HYDROCHLORIDE

PENETRATING AND PROLONGED SURFACE ANESTHESIA

1. Carabelli, A.: *Diseases of the Chest*, 15:532, May, 1949.
2. George P. Pilling & Sons, Company, 3451 Walnut Street, Philadelphia 4, Pa.

Winthrop-Stearns INC.

NEW YORK 13, N. Y. WINDSOR, ONT.

Pontocaine, trademark reg. U. S. & Canada, brand of tetracaine